Emergent Practices and Distributed Emotions in Educational Game Play

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Abstract: This paper discusses the learners’ encounters with an educational game called DinoPlates, which intends to support playful learning for secondary level Earth science concepts. DinoPlates simulates and lets learners control the Earth’s processes and search for dinosaur fossils. We contend that the emergent interactions observed in playing DinoPlates may implicate a potential for liberalizing the social practices of the digital generation through an educational game play. Findings with Singapore secondary male students indicate that different pairs playing the game identified different practices for achieving their emergent goals. We discuss the opportunities that the design of DinoPlates affords for emergent interactions in game play, and the ways learners’ emotional resources influence their practices.

Keywords: Educational game, distributed emotions, informal ideas, playful learning

1. Introduction

We have built Everest! We built Everest! We defeated Everest!

Leon and Justin, during game play

The types of learning that take place in teenagers’ daily use of digital media (e.g., web 2.0, social networking, online games) are characterized by the interplay between unlimited resources and environments to create and experiment; and the growth of their ideas, passion, and agency (Thomas & Brown, 2011). The above excerpt is from a pair who played DinoPlates together. DinoPlates, an educational game for Earth science learning, simulates as well as lets players control the Earth’s processes (i.e., tectonic plate movement and erosion) and search for dinosaur fossils from different geologic time periods. Leon and Justin had created towering mountain peaks in DinoPlates, and were announcing their achievement with reference to Mount Everest to their classmates. It gives us a glimpse of their excitement, and a potential growth in their passion for the learning.

The potential for learning with digital games has been of interest to researchers since the 1960’s (e.g., Boocock & Schild, 1968), which has continued with different ideas and interests. Papert (1980), for example, created children’s programming environment for creating games and building knowledge. More recently, Gee (2008) put forward learning principles seen from game plays and advocated digital games’ potentials for education. On the other hand, there has been accompanying tensions between the need for playful learning (i.e., gaining knowledge and skills for better game-playing) and the need for educational values that are expected in school. This paper pays attention to the ways in which learners exhibit social practices of the digital generation, i.e., a new culture of learning (Thomas & Brown, 2011), when they encountered DinoPlates. In particular, we are interested in what sparks learners’ emotional engagements in their game play that give rise to their ideas, passion, and agency. The work detailed in this paper draws on our implementation in an all-boys secondary school. The analysis was guided by following questions: 1) what kinds of learner interactions and practices emerge during game play?; and 2) how do the learners express their ideas and feelings about their practices? We derived our analysis from the video and audio recordings we collected during their in-class gameplay and interviews. We focus our observation on their interaction as a pair playing the game as well as how they respond and connect with other participants. The examples from our study illustrate the kind of learning that took place through their gameplay and conversations.
2. Emotions, Practices and Playful Engagement

Introducing new objects or new ways of using objects within a community requires its members to transform their ways of doing things, adopt new language, or play different roles outside their community boundaries. In many ways, the new objects may lead to transformation of the community itself (Tsurusaki, Calabrese Barton, Tan, Koch, & Contento, 2013). Digital games can create shared spaces that embody objects from disciplinary practices and transform the practices of school learning. Such possibilities are relevant to how game environments consist of models: they may model complex interactions in social, geographical and political settings as in The Sims or Civilization, simulate scientific principles found in many physics-based games, e.g., Angry Birds, and depict our cultural y, which are most likely accompanied by e, Purushotma, Robinson, & Weigel, 2007; gentleman interactions observed in playing e, we then discuss : when learners find e, and s, the new w workshops implementation of the previous earth system science This study was part of a long 3. emergent practices (cf. McCaslin, 2009) enable learners’ practices with the game. We contend that the emergent interactions observed in playing DinoPlates – as opposed to planned/designed activities – may implicate a potential for liberalizing the social practices of the digital generation in formal school settings. Such interactions emerge and implicate learners’ practices while socially situated in a particular learning and playing context. Playful learning is one of the important practices of the digital generation: it highlights learners’ experimenting with their surroundings and embracing new things and changes, through which they invent and solve problems and advance their knowledge and skills (Jenkins, Clinton, Purushotma, Robinson, & Weigel, 2007; Thomas & Brown, 2011). Conceptualizing learners’ interactions from the perspective of their emergent practices (cf. McCaslin, 2009) enables us to examine their actions and conversations in a meaningful manner. We use the word, “emergent” as being prominent at a particular situation.

Central to this interplay between play and learning are learners’ emotions. Learners constantly appraise what is presented in the game and act accordingly (Eynde & Turner, 2006). Learners’ ideas, emotions, and actions are sociocultural practices that often emerge in context. Learners’ emotional engagement truly become their resources for playful learning: when learners find personal meanings of their activities, their emotions could direct their attention toward them (B. Kim & Kim, 2010; Pekrun, Goetz, Titz, & Perry, 2002). Learners’ different ways of being and doing things are enacted in different settings and may shift depending on the situational demands (Gee, 2010; Roth et al., 2004), which are most likely accompanied by various emotions. In the following, we examine learners’ expressions that indicate their emotions as resources for their emergent practices, and thus indicating their playful learning. Their emotion-bound personal meanings are implicitly played out by learners themselves in this particular gaming context and affect their practices with the game. We start by describing the design of DinoPlates and consider how it affords for emergent interactions in playing the game. Based on what we observed from the video recordings, we then discuss the emergent practices and the ways in which learners’ emotional resources influence their practices.

3. Context of the Study

This study was part of a long-term collaboration between a university and an all-boys secondary school in Singapore. Some teachers and students of the school were involved in the design and implementation of the previous earth system science educational game prototypes. The game evolved in stages by involving learners and teachers as design partners in five progressive informant design workshops (Kim, Tan, & Kim, 2013), and DinoPlates is the latest game prototype.
3.1 The Game: DinoPlates

*DinoPlates* models convergent and divergent movements of a tectonic plate, layers of rocks, patterns of dinosaur fossil discovery (e.g., elevation, rock types), and natural forces that change landscapes (e.g., erosions by wind and rainfall). *DinoPlates* requires players to consider where and how fossils are exposed for their fossil search, which is similar to how paleontologists work. The development of *DinoPlates* incorporated learners’ design ideas. In our informant design workshops, learners often designed quests involving plate tectonics: using tectonic forces as their power to achieve goals in the game (e.g., creating mountains, triggering volcanic eruptions) was the key component of their quest ideas (Kim et al., 2013). Our design incorporated learners’ design ideas as well as our principle of situating concepts and knowledge within the disciplinary practices. Meaningful contents and activities support playful learning practices in educational games and help learners to engage their emotional resources for school learning and practices (Kim & Kim, 2010). Players directly affect the landscape to create mountains and erode lands and hills. Modeling plate tectonics is not an easy design task, not only for the complexity of the process but also for its vast scales of time and space. How to both model these processes and make them visible to players was an important issue in our design of *DinoPlates* (see Figure 1).

![DinoPlates game interface](image)

**Figure 1. DinoPlates game interface**

In *DinoPlates*, each player has a tectonic plate: one side is a convergent tectonic boundary (thus rising and forming mountains) and the other side along a divergent boundary (thus fracturing and decreasing in elevation over time) (see Figure 1a). The plate has a total of 10,000 squares. In Main View, the plate is a 10 x 10 map of grid squares, each of which in Detailed View expands to another 10 x 10 grid. Each square is many layers deep, comprised of different rock types and geological periods. Players have access to topographic and geological maps, and they can explore specific grid squares of the plate. When a player clicks on a square in a detailed view, the game displays information about the top three rock layers (rock type, geological age, thickness), and the player is given the option to dig for fossils there (see Figure 1b).

Players complete mini-quests and receive badges in *DinoPlates*. They range from simply reading the geological map; to finding a fossil at an elevation over 6,000 meters; to building a mountain over 10,000 meters high; to conquering a geological time period by discovering all the available fossils from it. Players can only dig the top layer of a square, so they must work to expose the desired rock layers. To do this, they can purchase and use various forces that modify the landform: winds and rains of various strengths, and convergent and divergent tectonic forces. They are deployed in units of many years to yield visible results in the game. Players earn coins and points as they excavate fossils, and the badges they earn enable them to complete the game.

3.2 The Study: Playing DinoPlates

The subjects of our study were a cohort of 12 to 13-year-old secondary one (grade 13) students in an all-boys school. Four classes played the *DinoPlates* prototype during supplementary geography lessons, and we gained informed consents from only some of the students from two classes to allow
us to study their game play. The sessions covered two periods (90 minutes) per class. Before allowing the students to enter the computer lab, the teacher asked them to find a partner to work with. They were paired to encourage discussion among themselves. In total, we collected data of 21 groups from two classes. The students collaborated in pairs with an exception of one group with three boys.

The teacher first had them sit away from the computers in order to brief them on the objectives of the session (i.e., experiencing and experimenting with various knowledge and skills from their geography lessons) and orient them with some open questions. He displayed the items from the DinoPlates’ Store and discussed with them what could happen with such forces (e.g., heavy rain for 10,000 years). He then showed the introductory video that highlights the features of the game. Each pair was given a worksheet, on which they could record data on their fossil searches and changes in landforms. This activity with the worksheet was intended to create resources for their reflection and discussion after the game play. Their game play and group activity lasted about 40 minutes, including the time spent on starting up and creating their account. As we designed this prototype to be completed in about 60 minutes, students were encouraged to continue the game at home. The teacher gathered them again in the open area away from the computers and proceeded to debrief the students. The discussion was focused on what they observed, what they thought was happening, why they thought they were able to find certain fossils in certain areas, and what other questions they had around the fossils, rocks, and landforms.

The game design intended players to use the embodied knowledge within the game, which include rock types, plate movements and land formation, and properties of rock layers and fossils. We expected the players to engage in both gaming practices (i.e., examining and strategizing for quests) as well as disciplinary practices (i.e., examining location indicators in determining where to find fossils, evaluating layer and fossil properties, and using earth changing effects to facilitate their fossil search based on their understanding of fossils, layer properties and landforms).

3.3 Data Collection and Analysis

Video data was captured during the course of these sessions. The team set up the computer lab with individual webcams and screen capture software in advance. The recording captured students’ expressions and discussions together with their in-game interactions. After initial analysis of the video recordings of the game play, we interviewed students by watching and having conversations around the video recordings of their game play (7 pairs and 1 group of 3 students). As an exploratory study no specific themes were pre-conceived in the initial phase of the analysis, but the following questions guided our analysis: 1) what kinds of learner interactions and practices emerge during game play?; and 2) how do the learners express their ideas and feelings about their practices?

The observation notes and video data were initially chunked into meaningful episodes and activities (i.e., logs) adopting the interaction analysis method (Barab, Hay, & Yamagata-Lynch, 2001; Erickson, 2006; Hay & Kim, 2007; Jordan & Henderson, 1995), to identify critical events, flow, and shifts in the process. Drawing on the logs, we started to look for themes and patterns, discussed them between the two researchers, and returned to the data for verification. We compared and contrasted the ways in which various components of the games were taken up by the learners in these events (Glaser, 1965; Strauss & Corbin, 2008). We examined how the learners were creating meanings and expressing their ideas, which indicate their existing or shifted ways of communicating, doing, and being in this particular context (Gee, 2010). Their interactions with the game and each other allowed us to identify categories useful in understanding how they relate to the game and also the practices they introduce to make the game more meaningful to them.

4. Emergent Practices and Distributed Emotions in Playing DinoPlates

Playing a game during school time provides a unique situation whereby the learners may constantly move in and out of the various practices (i.e., gaming practices, out-of-school social practices, and school practices). Out of the eight groups we observed as well as interviewed, we chose two groups (two pairs with pseudonyms) to discuss two of the themes to be presented in this paper. These two groups represent how learners mobilize informal ideas while searching for fossils and how they pursue situated and emergent goals during game play.
Danny and Zheng Yi are from an academically weaker class within their cohort. The school, however, is one of the higher ranked schools in the country. Zheng Yi came to the interview alone because Danny was not well on that day. Zheng Yi personally plays Team Fortress and Minecraft, and he pointed out that Danny plays Blackshot. He plays computer games for about 30 minutes to 2-3 hours a day depending on the time of the year (he plays less during exam time). He thinks Danny plays many other games everyday and is very good at them. It seemed that Danny knows he is better gamer than Zheng Yi: he called Zheng Yi a “noob”, when he made a mistake during game play.

Leon and Justin are from another class, which is considered a “high achievers” class in their level. They both mentioned Backyard Monster (a Facebook game) and Minecraft as games they play. They named their tectonic plate Korath, their favourite monster character from Backyard Monsters. They described Korath as a creature made of magma and covered by pieces of rocks, but they did not intend to associate it with the characteristics of the game.

Our analysis was focused on their actions and discourses that were emergent and not necessarily intended by our design of the game. The findings indicate that different groups identified different practices for achieving their emergent goals. We discuss how students approached their search for fossils, and how their goals and practices emerged during the game play. For each theme, we first discuss the general pattern emerged from various groups, and then provide an illustrative case from one of the groups described above.

4.1 Approaches to Fossil Search: Mobilizing Informal Ideas

We witnessed a range of modus operandi employed by the students to achieve the goal of finding fossils. They include relying on the information on fossil probabilities, looking for the appropriate rock types using the rock distribution map, finding target area to change the landform, digging as many places as possible (trial-and-error), or combinations of these. The most often seen strategy is reading the values of “fossil probability” presented in a table of information before they click on the “Dig Here” button. Figure 2 shows the information box, it appeared when a pair clicked a tile in an area (coordinates 12, 44). Each row shows a layer of the rock with their properties, and the line drawn across the window is the trace of mouse movement.

![Figure 2. Pop-up Box for Digging a Tile](image)

Fossil probability value of 0.9 in the top layer indicates a strong possibility of fossil finds from Jurassic period, which is also relevant to its rock type (i.e., limestone). Many students relied on the reading of the fossil probability to locate fossils as a way of deducing the fossil presence. Other information in Figure 2 includes the thickness and durability of the layer, which are useful if they are interested in eroding the layer to reach the next layer. Some students indeed added another step by using some earth-changing effects (wind and rain) that was followed by an excavation of fossils in the deeper rock layer.

For Danny and Zheng Yi, examining the fossil probabilities was one of the possible means for their fossil search. Earlier in the game play, they went into the shop after earning some coins with a mini-game instead of spending the coins to dig for fossils. Zheng Yi controlled the mouse most of the time, and Danny told him to buy Rain Monsoon (strongest and most expensive among different types of rain effects). They discussed about Divergent force, but Zheng Yi bought Convergent force. Looking at the items they had, Danny initiated the idea of using the convergent effect to create mountains and then apply the rain monsoon effect to cause a landslide to expose fossils.
Zheng Yi: ((enters the inventory menu to check on the earth changing effects they purchased: Rain monsoon and convergent tectonic effects are in their inventory))

Danny: (((laughs)) You, you, you convergent right, then you (form) one mountain, then you (dig) bones.

Zheng Yi: (use) rain monsoon.

Danny: No, (((laughs)) you, you put convergent, make it damn high first, then you go put rain monsoon, landslide all the way.

Zheng Yi: Explore this ((chooses an area in the main view to explore))

Danny: You should put it here ((points at an area on the monitor screen/main view)), then you like monsoon all (the things).

Zheng Yi: (This one) monsoon (here)

Danny: No. You convergent first, then everything damn high ((hands gesturing a mountain peak)) ((laughs)), then you rain monsoon, then whole thing fall.

Danny and Zheng Yi were not articulating fluently when they were describing their strategies to expose fossils. We, however, can see that Danny constructed his logic by adding elements to his explanation as he tried to convey his idea to Zheng Yi several times. Danny initially only had the idea of forming a mountain to find fossils, and then he added rain monsoon effect when Zheng Yi mentioned it. In the end, in order to better express and simulate what he was imagining, he used his hands to gesticulate the peaking and eroding mountain. Although he did not express much at that time, Zheng Yi seemed to be mobilizing his informal ideas and knowledge on how the earth changes. He explained their approach as following during the interview:

We used convergent and rain effects because the effects are more drastic, like more changes… Because we tried, and it ((rain)) seems to clear more lands so we want to use rain (to clear quickly), and convergent to show us more ((fossils)). In class also learn that. Water will erode faster than (wind)… It's to show the bottom of the surface ((the lower layer of the plate)), because the bottom (pushed up on top then washed) down, I think… (First) convergent, then wash down so that, even more exposed.

Danny and Zheng Yi’s approach seems to demonstrate how some students were able to use and experiment with their own informal ideas and prior knowledge on how fossils are exposed and how the land goes through changes. Such informal ideas are the most important resources for their learning (Kim et al., 2012; Kim et al., 2013), and we see the potential of their everyday learning practices being brought forward while playing the game. At the same time, learners expressed the prospective simulation of the game and its earth changing effects (i.e., representations) with words that emphasize on what they imagine as exciting changes (i.e., drastic changes, emphasis added in the excerpts above). Danny’s persistence in expressing the earth’s processes reveals how closely he is connected to his own ideas. It illuminates how Danny anchored his emotional relationship with the content (i.e., being able to experiment with his own ideas) and with representations to be processed based on their choices (i.e., mountain formation and erosion).

4.2 Situated and Emergent Goals

Playing an educational game with their peers in the school computer lab certainly provides a very different atmosphere from a teacher delivering a traditional lecture in their classroom. It is different from their out-of-school gaming situations. Learners in this situation are constantly navigating among the various contextual cues as gamers, playmates, and students, and we observed that their personal goals emerge in the course. Such emergence especially came with students’ experimenting with their ideas, not only to find more fossils (as in Zheng Yi and Danny’s case) but also just to see what happens with the simulated environment in DinoPlates. A pair, for example, tried to excavate the sea area to test the possibility of fossils in the waters: the game offered a safe space for the players to experiment. In another group we observed, one of the boys was trying to influence his partner, who is on task with fossil searching, to join him to create mountains after seeing the “Build a 10000 meters Mountain” icon on the Quest bar. As they go along, their game trajectory included the purchase of more convergent effects to create mountains. Such emergent goals are triggered by different events
for each group, as they were playing the game and interacting with their peers, the teacher, and researchers.

For Leon and Justin, their goal of creating a mountain emerged when the teacher commented on what they did in the game. When the teacher was walking by their computer, he observed that their landscape was dominated by a massive mountain:

Teacher : What monstrosity have you created? ((referring to the massive block of mountains formed in their landmass, see Figure 3)).

Justin : ((controlling the mouse)) Huh?

Teacher : It’s huge.

Justin : I know. (Found) it.

Leon : ((giggling)) Monstrosity… ((continue giggling as the teacher walks away)).

Justin : Maybe you know (where it is). ((In the main view, they maneuver the frame and position the group of mountains to the fore)).

Leon : Eh, do some more.

Justin : ((selecting and exploring an area by the mountains)) I am going to try blowing up, you know, the tall area? Yah? I am going to try blowing it up.

Leon : How?

Justin : OK, let’s… ((entering the Inventory menu, choosing the Convergent tectonic effect, and dragging the effect to the mountains)).

Leon : Yah, dump it there, dump it there.

Encouraged by their teacher’s comments, Justin and Leon set off to create more ambitious ones. They employed convergent tectonic effect generously on the mountain to cause it to elevate further. This self-driven task was performed with much pleasure as both Leon and Justin “conspired” to create something of monumental scale. They spent the next few minutes applying more convergent forces on the plate, which triggered more effects on the land mass (i.e., stronger convergent forces on the grid squares they chose subsequently causing other parts of the plate to converge and raise higher).

![Figure 3. Justin and Leon’s Korath Plate](image)

In the next excerpt, Leon had dragged convergent tectonic effects onto the mountains. They are waiting for the results of the effects indicated by exclamation marks. At times, the game will generate effects and exclamation marks automatically without the need for players to plant any effects on the grid squares. These exclamation marks when activated, display information on the type of natural phenomenon that has occurred. Blue exclamation marks would show up and blink to alert the players to click on it when certain events had happened (e.g., erosion of the landmass or convergence of the plate by the player’s application of effects or by the system’s simulation). When they clicked on a blinking exclamation mark, it announces that rain monsoon had taken place:

Justin : Oh, no, no, no, that one is a natural one. Wait for one of those (we put). ((waiting for the Convergent tectonic effect timer to complete the countdown)). ((A blue exclamation mark appears randomly to convey a natural event taking place.))

Justin : Eh, another one. ((the blue exclamation mark)).
Leon: See, one. ((clicks on the mark, and it disappears)) Eh, what's wrong?
Justin: Just wait, just wait. ((A box pops up congratulating them for accomplishing a task of building a 10,000 meters high mountain in five minutes and earning 1000 coins))
Justin: We have built a mountain.
Researcher: Oh, built a mountain. You have finished. ((Leon giggles)).
Justin: Whoaaa… ((Leon starts to giggle louder when they change the view revealing a taller mountain)) All those convergence really work. ((Leon laughing)). All those convergence really work. ((two other convergent effects they planted turned to blue exclamation marks consecutively and Justin clicks on them)).

They were ecstatic when they built a 10,000 meters tall mountain, and continued to put more convergent tectonic forces. As they saw more mountains were peaking up, they invited other friends to witness what they had created and announced that they built and defeated Everest. When we asked them about it during the interview, they said,

Leon: It's actually a mountain because of the convergent plate. Then they were folding and creating a large mountain. And later on, we actually decided to, like, make it bigger… 'Cause, Mt. Everest's supposed to be the tallest mountain so we wanted to make it even taller than that… The time was almost over so we tried to have a bit more fun with the (world) and so we actually just built this gigantic mountain and then after that… with reference to Everest.

Justin: ((They used more convergent effects because)) just curious to see what would happen. See how, how it can be… We spam on it ((convergent boundary))…’Cause we did what we wanted to do, (so we were) having a bit of fun ((with regards to announcing Everest)).

Leon and Justin introduced their personal goal into their game play when they decided to apply multiple effects in a single area. This kind of motivation to explore and create can become a powerful resource for playful learning during the game play. When they are engaged to complete personal goals, they are empowered by their decisions, and their accomplishments become personally meaningful. Such endeavours we saw from Leon and Justin are highly situated and emergent in this particular context: there was a limited play time within the school’s curriculum schedule, there were adults who acknowledged their accomplishments, and there were other classmates whom they could share their achievements immediately. In contrast to Zheng Yi and Danny’s account, Leon and Justin’s emotional relationship (i.e., excitement expressed through their giggling and laughing and their words of awe) is associated with how the game created the representations beyond their expectations, how their teacher and their classmates respond to the changes, and how the concepts (i.e., convergent boundaries and how high mountains in the world formed) existed in textbooks came into play.

5. Discussions: Evaluating Objects, Environment, and Accomplishments

What we have discussed above is the glimpse of the possible interplay between their play and learning. There were variations in students’ approaches to fossil search, but mobilizing their ideas and experiences as students and game players was a common practice among different groups. Their goals and practices emerged within the context of game play and also indicate an interplay between formal and informal practices: students were focused on their practice of playing and experimenting with the game, but at the same time were amused and excited by the events occurred in the game and the social activities they engaged in with their friends.

During the game play, many of the pairs working together compared and announced their achievements with their classmates around them. Their actions informed us that they were sharing information on what they were doing and at the same time inviting their peers to join similar practices. They looked for indicators of their status as game players and introduced competitions among them. Leon and Justin, as discussed above, were very excited to announce their accomplishments, when they said, “We defeated Everest.” Such status enhancement and competition were within their game play (i.e., defeating Everest) as well as with their friends around them. They are able and empowered
to create, discover, and evaluate various indicators (e.g., the highest mountain in the world, the properties of dinosaurs they find) by creating their personal and social goals situated within this context. Similar youths’ coveting for status and ranking through new media production, games, and social media was described by Ito and colleagues (2010), whereas student initiated these elements into the formal space in our context.

Playful learning is one of the important practices of the digital generation: it highlights learners’ experimenting through their actions with their surroundings and embracing and familiarizing new things and changes, through which they invent and solve problems and advance their knowledge and skills. Two pairs in our illustrated examples above have shown their capacity to experiment and invent. Central to this interplay between play and learning, lie students’ emotions. As discussed above, Leon and Justin were experimenting with the game environment to explore how the convergent effects work as well as to have “fun”, and giggling and laughing were common in their group play. While developing his strategies to expose fossils in the game, Danny connected the mountain formation and erosion processes with his approach and described it to his partner, Zhengyi with much laughter and conviction. Such emotional engagement truly become their resources for playful learning (Kim & Kim, 2010), and it shows the learning potentials and design implications for an educational game that can invite their practices of play. For Leon and Justin, their interview revealed that their game play continued at home and triggered them to search and read more information about the dinosaur fossils they found.

Playful learning also involves evaluating their artifacts and actions, and expressing their judgments through their words and actions. When Justin told Leon, “Wait for one of those (we put)” for their convergent effects, they value their actions they performed earlier on the game rather than effects automatically created by the game. In the exchanges not reported in this paper, Danny and his friends compared fossils they found and they wanted to know if other groups have found fossils of a whole dinosaur rather than parts (e.g., tooth, claw, jaw). Learners also evaluate their own actions and express their judgments when they play. For examples, Leon and Justin called their action of putting many convergent effects as “spamming”, expressing the value they see for such actions. For Justin and Leon, the words used in action (e.g., fighting and shooting) games seem to express their excitement and emotional attachment to their current game interactions. When they decided to build high mountains, Justin told Leon that he would try “blowing it up.” Leon, on the other hand, excitedly announced to his friends that they have “defeated” Everest, as they know that it is the highest mountain in the world. By using such informal terms of play to describe their actions, learners situate themselves in a playful mode within a formal school setting.

6. Conclusions

We recognize and emphasize that what we observed above are highly situated in this context: (1) the game play was with a classroom full of boys, many of whom are experienced with playing games; (2) there were tasks given by the teacher and being created by themselves; and (3) their classmates as well as the presence of the teacher and the researchers constantly influenced their interactions. For example, instead of chastising and regulating their overzealous excitement in the formal space, the teacher played the role of a “co-conspirator” (Ito, 2010), rousing Leon and Justin’s interests with his comments encouraging them to make advancements in the game. This spontaneity seen in students may say something about classroom teaching and the potential of setting up a nurturing learning space. In our case of educational game play, learners’ emergent interactions as students, playmates, and gamers can all be productive in their learning efforts, in which they use their informal ideas, negotiate for their ideas and roles within the group, create personal goals and competitions, find ways to have fun, create and solve problems together, and seek recognitions and confirmations from the teacher and peers. Learners’ playfulness and excitements were expressed through their actions and terms they used. We believe that the skills required in the new media culture (as discussed in Jenkins et al., 2007) are used in our learners’ everyday social practices and that we need to provide learners with the opportunities to recognize their own legitimate ways of learning and use them well in the school contexts. We hope that our on-going efforts provide design implications for engaging learners in playful learning potentially liberalizing their social practices of the digital generation.
References


Investigating Factors Affecting Conceptual Learning Progression when Playing Digital Game-based Inquiry Learning for Energy Education

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Abstract: One of the challenges of promoting students constructing knowledge on abstract topic as energy is helping them make the relationship between the theoretical-world and their life outside the classroom, through inquiry of the elements of energy consumption by daily used household electrical appliances in the digital game. Factors that increase students’ conceptual learning progression in the digital game-based inquiry learning are challenged to be investigated. In this study, factors of Enjoyment, Inquiry, and Intention to Use were selected as important attitudes in learning game and promoting conceptual learning progression. To verify the effectiveness of the game, sixty-six secondary school students participated in the digital game-based inquiry learning for energy education. The results showed that the game impacted moderately on improving the students’ conceptual understanding progression on energy consumption topic, students’ inquiry of the game has a significant relation with their learning progression, and students’ enjoyment and intention to use with the game do not significantly have a relation with their learning progression. Our results suggest that there are attitudinal factors affecting conceptual learning progression gained by the digital game-based inquiry learning.

Keywords: Game in education, learning progression, energy education

1. Introduction

It is known that school science subjects, like physics, chemistry and biology contain lots of theoretical concepts which students find difficult to understand and thus have misconceptions in it. Because of this, students rarely link the knowledge gained from those sciences in day-to-day life. This is all due to the narrow relation between how they are taught and what they learn (Kurt and Ayas, 2012; Ozmen, 2008). Normally in traditional teaching approach, teachers often over-rate the importance of their content and under-rate their impact in students’ learning. Thus, attempts to teach students all that they need to know become ineffective because students forget much of the content that they memorize. Most of the time in traditional teaching, teachers concern much about time limitation for teaching vast content of the subjects so they rarely encourage students in class discussion, collaborative learning, and inquiry-based activities that often take time. However, for effective learning, teachers must develop learning activities that encourage students on how to use scientific knowledge to solve important queries and help in deep thinking rather than worrying about covering the content. Deep thinking is essential because understanding is the residue of thinking. To encourage thinking, learning should incorporate activities that create a joy, an excitement, and loves for learning so that the students will be impatient to run home, study, and contemplate – to real learning (DiCarlo, 2009).

In the recent years, there are varieties of resources developed and are available. Incorporating such resources can be the best appropriate instructions that can fit the goal of achieving active learning. This has been a challenge for science teachers especially to teach abstract concepts, such as energy to young children (Duit, 1981; Yuenyong, Jones and Sung-Ong, 2011). So there has been always hunt for better learning method(s) to inculcate this concept in students because energy education has become an
area of major importance for those who are responsible for school teaching. As per DeWaters and Powers (2011), energy education enables clients to identify the better ways to save energy. However, the study indicated that while almost everybody agrees that they want to conserve energy, this often does not translate into action. Further, the study also showed that domestic energy usages are invisible to the consumers most of the time. This is simply because most people have only a vague idea of how much energy they are using for different purposes and what sort of difference they could make by changing day-to-day behavior or investing in efficient methods. For this reason, energy consumption has not declined significantly in reality (Boyd, 2002; Yang, Chien and Liu, 2012). This difficulty may be due to the fact that users usually either do not know how much electricity is consumed by their household electrical appliances or do not have any idea of how to save electricity in an appropriate way. As stated by Bates (2003), to meet the consequences of the paradigm shift from industrial age to information age, the current approaches and methods of instructions are insufficient. Eventually, the instructional designers are facing with the challenges of making learning situation to fit an instructional design/development of model rather than selecting suitable model to fit the needs of changing learning situations (Gustafson and Branch, 2002).

In recent years, there are many books and articles published, indicating various approaches for learning the different forms of energy, energy transformation, and the law of conservation of energy (Aggul, Yalcin, Acikyildiz and Sonmez, 2008). However, student’s prevailing ideas about energy are still found to be different from the scientific perspective. These days, a number of active learning units employing simulations and games have been developed for educational purpose in many disciplines like mathematics, science, engineering, humanities, and social sciences (Cai, Lu, Zheng and Li, 2006; Eck, 2006). Many students prefer learning by using computer games as it has lots of benefits in students’ habits and interests (Gee, 2006; Premsky, 2007). Games in education provide students to interact and gain learning experience from those activities that are closely relate to realistic situations that help students to apply their knowledge, skills and strategies to make decisions in their assigned task. Consequently, the students’ intellectual capacities and expectations about learning are enhanced. Papastergiou (2009) viewed that games and simulations integrated with contents help in teaching concepts through the transformation of experiences. Thus, the computer games can be used as learning tool to teach the factual information as well as worksheet activities for teaching and learning process (Spraggins and Rowsy, 1986).

Therefore, this study develops a digital game incorporating with inquiry-based learning strategy called Digital Game-based Inquiry of Energy Education to assist students’ learning in learning energy consumption. When playing the developed game, the students were encouraged to use electrical appliances for certain durations and to adjust the appropriate duration with each electrical appliance in a meaningful way of learning conceptual understanding of factors of energy consumption. In this study, we examined how much students’ conceptual learning progression size after participating in the developed game. Moreover, the factors that increase students’ conceptual learning progression in the game are challenged to be investigated to know the attitudinal factors affecting their conceptual learning progression.

2. Background and Motivation

According to National Research Council (2000), the authors summarized their research findings that students have different preconceptions about how the world works. If the teachers do not engage and link students’ initial understanding into new concepts then, they may fail to grasp the new concepts and information that were taught, or they may land up learning for the purpose of test only. Such that, to develop competence in an area of inquiry, students must have a proper foundation of factual knowledge, comprehend facts and ideas in the context of a conceptual framework, and organize knowledge that facilitates retrieval and application. Therefore, it is vital to choose appropriate strategy to develop learning tools (Charsky and Ressler, 2011; Chuang and Chen, 2009; Wang and Chen, 2010).

Inquiry-based learning is a strategy to enhance learning by engaging students in authentic investigations, achieving a more realistic conception of scientific endeavor as well as providing a more student-centered and motivating learning environment (Kubicek, 2005). Teachers act as a facilitator who provides the opportunity for students to observing, examining books and other sources of information using tools to gather, analyze, and interpret data which students learn from their
explanation, predictions, and communicating the results. (Krajcik and Blumenfeld, 2006; Kuhn, Black, Keselman and Kaplan, 2000). Regarding to provide opportunity for students to observe, gather, analyse, construct their own conceptual knowledge; in this study, the inquiry-based learning strategy was chosen to design a digital game-based learning to assist students explore the factors of energy consumption by using electrical appliances for certain durations and adjusting the appropriate duration with each electrical appliance. These features of the game might help students to improve their conceptual knowledge on energy consumption. As such, we hypothesize that:

H1: Students’ conceptual learning progression through Digital Game-based Inquiry Learning has medium gain size or high gain size when using concept of Hake (1998) normalized gain <g>.

When the digital game-based inquiry learning can help students to improve conceptual learning progression in medium gain size or high gain size; then, in our case, we can imply that it is successful digital game-based inquiry learning. Such that the students’ attitudes toward the digital game-based inquiry learning are challenged to be investigated to know the factor(s) affecting their conceptual learning progression. In this study, the factors of Enjoyment, Inquiry, and Intention to Use were selected as important attitudes in learning game and promoting conceptual Learning Progression.

Enjoyment is the degree to which activity is perceived to be personally enjoyable (Davis, Bagozzi and Warshaw, 1992). When the students participate in a game, they are reduced anxiety and feel confident to construct knowledge. This is the sense of enjoyment in the game (Vorderer, Klimmt and Ritterfeld, 2004). We can imply that higher levels of enjoyment affect higher conceptual learning progression size. Moreover, as mentioned above, the inquiry-based strategy is the method to which learning sequence is perceived to be personal inquiry. The term of inquiry while the students learn through a game facilitate exploration and help students construct conceptual knowledge on specific concept. We can assume that higher levels of inquiry affect higher conceptual learning progression size. In addition, the intention of use is considered as common factor on most of the game acceptance studies (Ha, Yoon and Choi, 2007; Hsu & Lu, 2004; Venkatesh and Bala, 2008). The students’ attitude toward playing or intention to use the game will facilitate the practical use of a digital game system. We can imply that higher levels of intention to use affect higher conceptual learning progression size. Hence, we have hypotheses as follow:

H2: Students’ Enjoyment with the digital game-based inquiry learning has a positive relation with their Learning Progression size;

H3: Students’ Inquiry with the digital game-based inquiry learning has a positive relation with their Learning Progression size;

H4: Students’ Intention to Use with the digital game-based inquiry learning has a positive relation with their Learning Progression size;

3. The Digital Game-based Inquiry Learning

For the purpose of our study, we developed the digital game-based inquiry learning. The main purpose of the developed game is to improve the conceptual knowledge of energy consumption. The developed game provides ways by which students can experience their subject in different manners. The game brings the world (reality) into the classroom and appeals to actively engaging students. While learning through the game, the students are provided opportunity to think more critically about their own progress and abilities. The developed game media follows the design rationale for the proposed game-based learning units that guide the students in transforming their knowledge on electrical energy consumption into their daily life applications. Furthermore, the learning game is embedded within inquiry-based learning approach. It helps students engaged in a new concept by relating their previous knowledge by exploring and explaining through their experiences, then elaborating on what they have learned, and finally evaluating their understanding on that new concept under the guidance of teachers. Eventually, this enhances students’ conceptual understanding of subject. Table 1 shows the summary of the developed game.

590
<table>
<thead>
<tr>
<th>Steps</th>
<th>Pictorial representation</th>
<th>Learning activities</th>
</tr>
</thead>
</table>
| 1. Engagement | ![Image](image1.png) | The lesson begins with scenario that commonly happens at our home. Example, father gets a monthly power bill claiming Nu. 6,500/- (Currency used in Bhutan). But his monthly salary is just Nu. 10,000/- now he has pay more than 50% of his income just on power bill. This arise curiosity and engage students to investigate the cause of power consumption. Teacher further encourages them with some common questions, like  
- list down electrical appliances operated at our home?  
- any idea how much energy is been consumed by those appliances?  
Eventually, teacher will link to learning unit. |
| 2. Exploration | ![Image](image2.png) | To investigate reason for high power bill; students explore the cases in “Energy Detective”- interactive simulated learning module to identify the factors for energy consumption. It also explains, elaborates and evaluate students understanding on transmission of electricity to our home, how power bill is calculated, unit of electrical energy is derived, etc. In the meanwhile, teacher keeps note of the findings and reinforce participants to find reasons to support their findings. |
| 3. Explanation | ![Image](image3.png) | After exploring through the interactive units to identify the factors for energy consumption, students solve problems provided in the worksheets and present their findings to the class. Teacher then displays and compares their findings, and ask them to summarize the findings in identifying the factors for energy consumption in electrical appliances. Subsequently, teacher introduces important formulas, relations and units related to energy consumption context. |
4. Elaboration

Theoretical knowledge of energy consumption is then extended into the interactive game “Energy Efficiency Game: know your power bill”. This provides students opportunity to apply the abstract concept of energy consumption to into practical, which help them to visual and understand clearly in a playful way. Students find ideas about rate of energy consumption and how to conserve it. Thus, the knowledge on energy consumption is elaborated into energy conservation. In the meantime, teacher ask the students the ways of saving more money while playing the game and encourage them to share the ideas with rest of the friends.

5. Evaluation

“Shopping: know your home electric appliance better” is an interactive game, students can interact and choose commonly used home electrical appliances from the list. This module evaluates students’ self-awareness in using electrical efficient appliances to conserve energy. Further, teachers elaborate the context into daily life situations and provide additional information on it and provide opportunity to students to share their knowledge on energy saving at their home and school. Finally, the teachers summarize/ debrief on the learning unit.

4. Research Methodology

We will investigate the four research hypotheses of this study. In the first research hypothesis (H1), a Digital Game-based Inquiry Learning has improve students’ conceptual learning progression in medium gain size or high gain size; results on H1 will lead us to the other three hypotheses (H2, H3, H4) in order to clarify which factors affect the students’ conceptual learning progression.

4.1 Experiment Procedure and Participants

The research design was one group pre-posttest design. A total of 66 tenth graders of secondary school students (37 females and 29 males) in eastern Bhutan participated in this study. The students were asked to learn with the digital game-based inquiry learning environment; that is the game led the students to explore factors of energy consumption, and guided them to construct their own conceptual knowledge via asking questions during playing game. Before participating in learning unit/game, the students were asked to take pre-conceptual test of the topic. After finishing learning activities on the game learning environment lasted 90 minutes in a time, they were asked to take post-conceptual test followed by
attitude questionnaire. They were asked to respond questionnaire only one time after finishing post-conceptual test.

4.2 Research Tools

To examine the first research hypothesis (H1), the research tools were a pre-conceptual test and a post-conceptual test; both of them were designed by three experienced teachers teaching same subject. Each test contained 20 multiple-choice items, and one point was scored for each correct answer; therefore, the total score of the tests was 20. The pre-conceptual test was evaluated the validity by three experienced teachers, and had the reliability value 0.63, implying that the test was reliable. Similarly, the post-conceptual test was evaluated the validity by three experienced teachers, and had the reliability value 0.60, implying that the test was reliable.

To investigate the other three hypotheses (H2, H3, H4), the attitude questionnaire was adopt from Giannakos (2013). In this study, there were 10 items in three factors of the questionnaire: Enjoyment (four items), Inquiry (three items), and Intention to Use (three items) as shown in Table 2. This questionnaire was measuring using a 5-points Likert scale ranging from “1 = strongly disagree” to “5 = strongly agree”. This questionnaire showed that the Cronbach’s alpha reliability value was 0.74, implying that the questionnaire was reliable.

Table 2: The research factors and their corresponding items

<table>
<thead>
<tr>
<th>Factors D</th>
<th>Definition</th>
<th>Items</th>
</tr>
</thead>
</table>
| Enjoyment (ENY) | The degree to which the learning sequence of using the digital game-based inquiry learning is perceived to be personally enjoyable. | *Item1:* Participating is more interesting using the digital game-based inquiry learning.  
*Item2:* Using the digital game-based inquiry learning is fun.  
*Item3:* I like using the digital game-based inquiry learning.  
*Item4:* I enjoy those aspects of my studying that require me to use the digital game-based inquiry learning. |
| Inquiry (INQ) | The degree to which the learning activity of using the digital game-based inquiry learning is perceived to be personal inquiry. | *Item5:* Using the digital game-based inquiry learning does help me explore factors of energy consumption.  
*Item6:* Using the digital game-based inquiry learning does help me construct my own knowledge.  
*Item7:* Using the digital game-based inquiry learning does help me building confidence in finding conceptual understanding of energy consumption clearly. |
| Intention to Use (IU) | The degree of students’ willingness to play the digital game-based inquiry learning. | *Item8:* I plan to use the digital game-based inquiry learning for studying in the future.  
*Item9:* I intent to continue using the digital game-based inquiry learning for studying in the future.  
*Item10:* I expect my use of the digital game-based inquiry learning to continue in the future. |
| Learning Progression (LPRO) | The level of students’ conceptual knowledge gained using the digital game-based inquiry learning. | The conceptual tests |

Table 2: The research factors and their corresponding items
5. Results

5.1 Students’ conceptual learning progression

The result of the first research hypotheses (H1): students’ conceptual learning progression through Digital Game-based Inquiry Learning has medium gain size or high gain size is taken to be the average normalized gain \(<g>\) by analyzing the conceptual pre-test and post-test. Hake (1998) defined the \(<g>\) as “High gain, \(<g> \geq 0.7\)”, “Medium gain, \(0.7 > <g> \leq 0.3\)”, and “Low gain, \(<g> < 0.3\)”. From sixty-six students’ conceptual pre- and conceptual post-test scores, the results show that there are 13, 34, and 19 students for high, medium, and low gains respectively. For overall result, as shown in Table 3, the conceptual score of pre- and post-test, the \(<g>\) is 0.46 indicating that the students have conceptual learning progression of their learning by gaining better conceptual knowledge after participating in the digital game-based inquiry learning environment. It is clearly that the progression of their conceptual knowledge has medium gain size which meets the H1.

Table 3: Learning progression of conceptual score by the average normalized gain \(<g>\)

<table>
<thead>
<tr>
<th>Conceptual test (Total score = 20)</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>66</td>
<td>7.56</td>
<td>2.30</td>
</tr>
<tr>
<td>Post-test</td>
<td>66</td>
<td>13.26</td>
<td>3.07</td>
</tr>
<tr>
<td>(&lt;g&gt;)</td>
<td></td>
<td>0.46</td>
<td></td>
</tr>
</tbody>
</table>

According to Table 3 results, this result suggests that learning with the developed digital game-based inquiry learning impacted moderately on improving the students’ conceptual understanding of energy consumption. As now we have proven the value of the digital game-based inquiry learning on conceptual learning progression. We will answer the other three hypotheses (H2, H3, H4) to identify which factors of the developed game influences students’ conceptual learning progression.

5.2 Students’ attitudes affecting conceptual learning progression

To examine the research hypotheses regarding the effect of ENJ, INQ, and IU on students’ LPRO, we divided ENJ, INQ, and IU on high and low categories performing by progression size; then performing a \(t\)-test including students’ LPRO as a dependent variable and the other three factors (ENJ, INQ, IU) as independent variables. As shown in Table 4, we can see that INQ has significantly effect on students’ LPRO, with a significant level of 0.05, while ENY and IU have not.

Table 4: Research hypotheses (H2, H3, H4) testing using \(t\)-test

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>Categories progression gain size</th>
<th>(T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning progression (LPRO)</td>
<td>Enjoyment (ENY)</td>
<td>Low Mean (S.D.), interpretation</td>
<td>High Mean (S.D.), interpretation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.46 (0.35), strongly agree</td>
<td>4.63 (0.32), strongly agree</td>
</tr>
<tr>
<td></td>
<td>Inquiry (INQ)</td>
<td>3.92 (0.64), strongly agree</td>
<td>4.77 (0.44), strongly agree</td>
</tr>
<tr>
<td></td>
<td>Intention of Use (IU)</td>
<td>4.57 (0.42), strongly agree</td>
<td>4.67 (0.41), strongly agree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.56</td>
<td>3.81*</td>
</tr>
</tbody>
</table>

\(p < 0.05\)

Although we notice that only INQ has the significant effect on students’ LPRO, observing Table 4, we must acknowledge that there is higher effect of IU than ENY. This indicates that the decision of students to use a digital game is higher effect than the enjoyment experienced through a
digital game on influencing the learning progression. Overall, Figure 1 clearly shows the positive influence of ENY, INQ, IU on students’ LPRO in which we can answer the research hypotheses (H2, H3, H4).

![Figure 1](image)

**Figure 1.** The effect of students’ attitudes in their conceptual learning progression gain size when playing the digital game-based inquiry learning

We can see that the three factors (ENY, INQ, IU) affect the students’ LPRO in the different way. As such to verify the strength of the relationship between factors, we used Pearson’s coefficient as shown in Table 5. Clearly, there is relatively strong relation among three factors. This indicates that students reflecting high enjoyment are more likely to explore knowledge by themselves through the game; students reflecting high intention to use the game are more likely to be enjoyment during learning; and also a digital game reflecting high inquiry-based activity are more likely to influence decision of students to use a digital game.

**Table 5: Pearson’s correlation coefficient between factors (ENJ, INQ, IU)**

<table>
<thead>
<tr>
<th>Factors</th>
<th>ENY</th>
<th>INQ</th>
<th>IU</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENY</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQ</td>
<td>.492*</td>
<td>1</td>
<td>.592*</td>
</tr>
<tr>
<td>IU</td>
<td>.549*</td>
<td>.592*</td>
<td>1</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.01 level

6. **Discussion and Conclusion**

This study examined the effectiveness of a digital game-based inquiry learning at the conceptual learning progression of energy consumption competences with the students of eastern Bhutan secondary school. From the conceptual tests, this study indicates that the developed digital game-based inquiry learning successfully improved students in Physics course. This result led us to investigate the relationship between students’ attitudes (Enjoyment, Inquiry, Intention to Use) and conceptual learning progression gain size regarding digital game-based inquiry learning. The findings indicated that Inquiry has a significant effect on students’ conceptual learning progression. Thus, we could suggest that Inquiry: the degree to which the learning activity of using the digital game-based inquiry learning is perceived to be personal inquiry could play a very crucial role in acquiring conceptual knowledge of students. On the other hand, the hypotheses H2 and H4 are rejected. As such, students’ enjoyment and intention to use indicate that there is no significant effect on students’ conceptual learning progression. Our study is also similar with several studies (Sumak, Hericko and Pusnik, 2011; Giannakos, 2013) that also deal with the effect of students’ attitudes (Enjoyment, Intention to Use) on learning performance when using digital games. Moreover, our study clearly
indicate the important roles of Enjoyment, Inquiry, Intention to Use in affecting the students’ decision to use the digital game-based inquiry learning (Table 5).

The research findings revealed that students reflecting high inquiry are more likely to gain conceptual knowledge through the digital game. As such, educators, researchers, and practitioners should provide a learning environment where inquiry feature is supported and fostered in order to enhance successful conceptual learning progression with the digital game. If we overlook students’ inquiry feature, it might have unfavorable effects on the conceptual knowledge constructing led to the conceptual knowledge progression.

Acknowledgement

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References


DiCarlo, S. E. (2009). *Too much content, not enough thinking, and too little FUN!*.


Revised Computer Game Attitude Scale

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Abstract: In order to fit students' needs, an accurate computer game attitude scale is needed so teachers and researchers can know among their students who can really benefit from the use of educational games. In this paper, the research team analyzes 218 students' responses of a revised computer game attitude scale and finds their computer game attitude relationships and differences among gender, grade, preferred gaming way and game playing experience.

Keywords: Educational games, gender issue, elementary school students, post-secondary school students

1. Introduction

Most games are in some way educational, even if they have not been originally designed to be. When the games are played, the games can introduce new concepts or reinforce existing ones for players. Consider a deck of cards. There are literally thousands of card games that can be played. In most card games players need to know basic matching skills to match card denominations or suits; card denominations are often added together, requiring math skills. Often cards must be counted and matched, requiring counting (Cribbage, 2013; War, 2013), matching (Go Fish, 2013; Rummy, 2013) and more complex mathematical skills (Contract Bridge, 2013; Cribbage, 2013).

More and more games are designed for teaching and learning in the last decade (Fletcher & Tobais, 2006). Many researchers believe that students can learn in a leisure and friendly environment (i.e., game) if the game is designed for specific learning subject (Gee, 2003; van Eck, 2007). Furthermore, researchers also find out that educational games can help students learning complex contents such like activities of daily living (Kuo, Chang, Lyu, and Heh, 2013), algebra cognition (Corbett, Koeodinger, & Handler, 2001), financial concepts (Jones, Chang and Kinshuk, 2014), history and culture (Ardito, Costabile, De Angeli, 2012; Chang & Chang, 2006; Garzotto, 2007), logic (Lanzilotti and Roselli, 2007), management information systems (Lu, Chang, Kinshuk, Huang, and Chen, 2014), programming language (Kahn, 1999; Kuo, Chang, Kinshuk, and Liu, 2010), and help elders with disabilities to improve selective attentions and to gain higher quality of life (Chen, Chiang, Liu, and Chang, 2012) as well as encouraging young females to do physical activity (Huang, Hung, Chang, and Chang, 2009). All experiments and pilots of educational games do show positive and encouraging outcome (Kapp, 2012; Prensky, 2007).

On the other hand, although many research find that there are gender differences on students' confidence in playing computer games and on how much students like computer games (Liu, Lee, and Chen, 2013; Lu, Chang, Kinshuk, Huang, and Chen, 2012), Lu and his colleagues (2012) have found that how students think about computer games and how comfortable they feel toward computer games are the two factors that significantly influence their voluntariness of using educational games. It is important to have an accurate measure for researchers and teachers getting clear idea of their students' attitude toward computer games, so proper supplemental learning tools like educational games can be offered to the right target – students who may really need and appreciate the alternative way of learning.

2. Computer Game Attitude Scales
Computer Game Attitude Scale (CGAS) is used to measure the player's attitude towards computer games. The scale was first introduced in 1997 and has proven to have strong validity and reliability in measuring attitudes (Chappell & Taylor, 1997). The CGAS has twenty items for testing two main subscales – comfort and liking. Liu and colleagues (2013) develop a New Computer Game Attitude Scale (NCGAS) by adopting items from Chappell and Taylor's CGAS and adding new items for new subscales and factors. There are sixty items proposed, in the NCGAS, for testing three subscales: cognition which includes two factors – learning and confidence; affection which includes liking factor; and, behavior which includes three factors – participation, leisure, and negative behavior). After validity and reliability tests, only twenty-two items kept in the final version of NCGAS questionnaire. The twenty-two items are used to examine three subscales (i.e., cognition, affection, and leisure) and five factors (i.e., learning and confidence in cognition subscale, liking in affection subscale, and participation and leisure in behavior subscale).

The research team further develops a revised CGAS based on NCGAS. As the NCGAS was developed for early adolescents, we remove some items according to the comments and suggestions made by research ethics review board and revise wordings of some items so the revised items can even be fully understood by Canadian children at ages 6 to 7 (i.e., 2nd grade elementary school students). There are seventeen five-point Likert-scale items (5 for "Strongly Agree" to 1 for "Strongly Disagree") proposed at beginning. The seventeen items are categorized into 4 factors listed below:
- Confidence: users' confidence in playing the computer game;
- Learning: users' perceptions of positive impact when computer games are used in learning;
- Liking: users perceived enjoyment for playing computer games;
- Leisure: users' thoughts on taking playing computer games as leisure activities.

Table 1: The proposed items of the revised Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Factor (CON)</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>Confidence</td>
<td>1. I am good at playing computer games.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Playing computer games is easy for me.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. I understand and play computer games well.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. I am skilled at playing computer games.</td>
</tr>
<tr>
<td>Learning</td>
<td>Learning (LRN)</td>
<td>1. I like taking courses that use computers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Using computer games in school is a good way to learn.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Playing computer games improves my eye and hand coordination.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Playing computer games enhances my imagination.</td>
</tr>
<tr>
<td>Affection</td>
<td>Liking (LIKE)</td>
<td>1. I like it when people talk about computer games.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. I feel comfortable while playing computer games.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. I am very interested in solving quests/questions/missions in computer games.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. I always try to solve the current quest/question/mission in the computer game.</td>
</tr>
<tr>
<td>Behavior</td>
<td>Leisure (LEI)</td>
<td>1. Playing computer games makes me happy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Playing computer games is part of my life.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. When I have free time, I play computer games.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. I talk about computer games with my friends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. I am not alone in a computer game as I can make friends there.</td>
</tr>
</tbody>
</table>

Beside the seventeen items, in order to find out the differences among gender, grade, preferred gaming ways, and game play experience, additional twelve items are included – (1) one item for gender; (2) one item for grade; (3) three items for the preferred gaming ways include single player, limited multiplayer, and full functionality of multiplayer gaming; and, (4) seven items for amount of hours every day in a week the respondent usually spend on playing computer games.
3. Validity and Reliability of the Revised CGAS

Principal Component Analysis with varimax rotation is used to examine items' validity within the factors. Items with factor loading less than 0.6 were not good enough for presenting the factor (Hair, Anderson, Tatham, & Black, 1995). At the end, a valid and reliable revised computer game attitude scale with four factors and 17 items is determined and confirmed.

The cognition subscale is identified into Confidence and Learning factors. The reliability of the entire subscale is good as its Cronbach's alpha value is 0.882 (George & Mallery, 2010). Moreover, the reliability of Confidence factors is excellent (i.e., its Cronbach's alpha value is 0.936 and is larger than 0.9) and Learning factor is acceptable (i.e., its Cronbach's alpha value is 0.704 and is larger than 0.7). Table 2 lists the factor analysis results of the cognition subscale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1: Confidence</th>
<th>Factor 2: Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON3</td>
<td>0.936</td>
<td></td>
</tr>
<tr>
<td>CON4</td>
<td>0.930</td>
<td></td>
</tr>
<tr>
<td>CON2</td>
<td>0.921</td>
<td></td>
</tr>
<tr>
<td>CON1</td>
<td>0.914</td>
<td></td>
</tr>
</tbody>
</table>

Factor 1: Confidence (Cronbach's alpha = 0.967)

| LRN2  | 0.795      |
| LRN1  | 0.694      |
| LRN4  | 0.670      |
| LRN3  | 0.662      |

Factor 2: Learning (Cronbach's alpha = 0.704)

Eigenvalue 4.476 1.356
% of variance 55.955% 16.948%
Overall alpha = 0.882, Total variance explained is 72.903%

The affection subscale only has one factor, Liking. The Cronbach alpha of the subscale is 0.748 and its reliability is acceptable. Table 3 lists the factor analysis result of the affection subscale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1: Liking</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIKE3</td>
<td>0.818</td>
</tr>
<tr>
<td>LIKE4</td>
<td>0.749</td>
</tr>
<tr>
<td>LIKE1</td>
<td>0.749</td>
</tr>
<tr>
<td>LIKE2</td>
<td>0.709</td>
</tr>
</tbody>
</table>

Factor 1: Liking (Cronbach's alpha = 0.748)

Eigenvalue 2.290
% of variance 57.242%

The last subscale, behavior, also has one factor, Leisure. The reliability of the subscale is also acceptable with its Cronbach alpha equals 0.754. The factor analysis results of the behavior subscale is listed in Table 4.
Table 4: Factor loadings and Cronbach’s alpha value for the behavior subscale of the revised Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Factor 1: Leisure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: Leisure (Cronbach’s alpha = 0.754)</td>
<td></td>
</tr>
<tr>
<td>LEI2</td>
<td>0.829</td>
</tr>
<tr>
<td>LEI4</td>
<td>0.827</td>
</tr>
<tr>
<td>LEI5</td>
<td>0.802</td>
</tr>
<tr>
<td>LEI3</td>
<td>0.775</td>
</tr>
<tr>
<td>LEI1</td>
<td>0.744</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td>3.167</td>
</tr>
<tr>
<td>% of variance</td>
<td>63.341%</td>
</tr>
</tbody>
</table>

The correlations among four factors are shown in the intercorrelation matrix in Table 5. All correlations in-between two factors are reached significance at level of 0.01. Moreover, the correlations in-between two subscales are also reached significance as the intercorrelation matrix in Table 6 shows. These two tables show that the three subscales and the four factors are coherent measurement in computer game attitude.

Table 5: Intercorrelation matrix of four computer game attitude factors.

<table>
<thead>
<tr>
<th>Factor</th>
<th>CON</th>
<th>LRN</th>
<th>LIKE</th>
<th>LEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LRN</td>
<td>0.501**</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LIKE</td>
<td>0.616**</td>
<td>0.569**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LEI</td>
<td>0.664**</td>
<td>0.649**</td>
<td>0.693**</td>
<td>-</td>
</tr>
</tbody>
</table>

**: Correlation is significant at the 0.01

Table 6: Intercorrelation matrix of three computer game attitude subscales.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Cognition</th>
<th>Affection</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Affection</td>
<td>0.683**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Behavior</td>
<td>0.753**</td>
<td>0.693**</td>
<td>-</td>
</tr>
</tbody>
</table>

**: Correlation is significant at the 0.01

Table 7 list the descriptive statistics of the three subscales and the four factors. The results show that students believe playing computer games is a good way for learning. Students are also enjoy in playing computer games and prefer playing computer games when they are free.

Table 7: Descriptive statistics of students’ responses to the four factors and three subscales of the revised Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Item Amount</th>
<th>Value Range</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition</td>
<td>8</td>
<td>1-5</td>
<td>3.950</td>
<td>0.889</td>
<td>-0.578</td>
</tr>
<tr>
<td>Affection</td>
<td>4</td>
<td>1-5</td>
<td>4.037</td>
<td>0.893</td>
<td>-0.863</td>
</tr>
<tr>
<td>Behavior</td>
<td>5</td>
<td>1-5</td>
<td>3.959</td>
<td>0.994</td>
<td>-0.779</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factor</th>
<th>Item Amount</th>
<th>Value Range</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>4</td>
<td>1-5</td>
<td>3.798</td>
<td>1.236</td>
<td>-0.716</td>
</tr>
<tr>
<td>LRN</td>
<td>4</td>
<td>1-5</td>
<td>4.102</td>
<td>0.803</td>
<td>-0.532</td>
</tr>
<tr>
<td>LIKE</td>
<td>4</td>
<td>1-5</td>
<td>4.037</td>
<td>0.893</td>
<td>-0.863</td>
</tr>
<tr>
<td>LEI</td>
<td>5</td>
<td>1-5</td>
<td>3.959</td>
<td>0.994</td>
<td>-0.779</td>
</tr>
</tbody>
</table>
4. Differences among Gender, Grade, Preferred Gaming Way, and Game Playing

This research compares the scores of the four factors and the three subscales that students in different groups (e.g., gender, grade, preferred gaming way, and average hours of weekly game playing) respond. Table 8 shows the results of comparing male and female students' responses by using t-tests. Students' responses in all of the factors and the subscales show significant difference. The results show that male students have higher confidence in playing computer games and enjoy more on playing computer games when they are free. Male students also have higher perceptions of believing computer games can be a tool for learning.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Gender</th>
<th>Mean</th>
<th>S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>Female</td>
<td>3.348</td>
<td>1.356</td>
<td>-5.242 *</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>4.194</td>
<td>0.965</td>
<td></td>
</tr>
<tr>
<td>LRN</td>
<td>Female</td>
<td>3.985</td>
<td>0.844</td>
<td>-2.035 *</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>4.206</td>
<td>0.753</td>
<td></td>
</tr>
<tr>
<td>LIKE</td>
<td>Female</td>
<td>3.793</td>
<td>0.999</td>
<td>-3.818 **</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>4.251</td>
<td>0.728</td>
<td></td>
</tr>
<tr>
<td>LEI</td>
<td>Female</td>
<td>3.725</td>
<td>1.088</td>
<td>-3.275 **</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>4.164</td>
<td>0.857</td>
<td></td>
</tr>
</tbody>
</table>

**: Correlation is significant at the 0.01
*: Correlation is significant at the 0.05

We also divide data into two groups according to students' ages. The two groups are elementary school and post-secondary school. We use t-tests to check if there are differences in students' responses between the two groups. The results in Table 9 show that there are significant differences between the two. Elementary school students have more positive responses to all factors and subscales than post-secondary school students. The results show that elementary school students believe that they are good in playing computer games and treating playing computer games is an leisure activity. Elementary school students also believe that they can learn via the game-play of computer games. In other words, educational games may be appreciated much more for elementary school students.

In terms of preferred gaming way: there are 15.1% of students prefer to play computer games alone; 7.8% prefer to play computer games which have limited multiplayer features; 57.3% prefer to play multiplayer computer games; 1.8% prefer to play both of single player and limited multiplayer games; 0.9% prefer to play both of single player and full function multiplayer games; 3.7% prefer to play both of limited and full function multiplayer games; and, 2.3% enjoy all kinds of games. Table 10 lists the analysis results of the relations between preferred gaming way and the revised Computer Game Attitude Scale. The ANOVA and the Scheffe's tests results show that in terms of learning from playing computer games there is no significant difference among students' responses from different groups. On the other hand, we can find that students who prefer full function multiplayer games have more positive perceptions toward learning from playing computer games than their counterpart: for instances, group 3 vs. groups 1 and 2; group 4 vs. group 1; group 6 vs. group 2; and, group 7 vs. group 4.
Table 9: Grade differences to the factors in CGAS.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Gender</th>
<th>Mean</th>
<th>S.D.</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>CON</td>
<td>Elementary</td>
<td>3.954</td>
<td>1.281</td>
<td>3.301*</td>
</tr>
<tr>
<td></td>
<td>Post-secondary</td>
<td>3.407</td>
<td>1.023</td>
<td></td>
</tr>
<tr>
<td>LRN</td>
<td>Elementary</td>
<td>4.194</td>
<td>0.851</td>
<td>3.125*</td>
</tr>
<tr>
<td></td>
<td>Post-secondary</td>
<td>3.871</td>
<td>0.614</td>
<td></td>
</tr>
<tr>
<td>LIKE</td>
<td>Elementary</td>
<td>4.149</td>
<td>0.924</td>
<td>3.290*</td>
</tr>
<tr>
<td></td>
<td>Post-secondary</td>
<td>3.754</td>
<td>0.745</td>
<td></td>
</tr>
<tr>
<td>LEI</td>
<td>Elementary</td>
<td>4.055</td>
<td>1.062</td>
<td>2.647*</td>
</tr>
<tr>
<td></td>
<td>Post-secondary</td>
<td>3.716</td>
<td>0.753</td>
<td></td>
</tr>
</tbody>
</table>

Subscale

<table>
<thead>
<tr>
<th></th>
<th>Cognition</th>
<th>Affection</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary</td>
<td>4.074</td>
<td>4.149</td>
<td>4.055</td>
</tr>
<tr>
<td>Post-secondary</td>
<td>3.639</td>
<td>3.754</td>
<td>3.716</td>
</tr>
</tbody>
</table>

*: Correlation is significant at the 0.01

Table 10: Students who prefer different gaming ways have different responses toward the revised Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Group</th>
<th>CON (Mean ± S.D.)</th>
<th>LRN (Mean ± S.D.)</th>
<th>LIKE (Mean ± S.D.)</th>
<th>LEI (Mean ± S.D.)</th>
<th>Cognition (Mean ± S.D.)</th>
<th>Affection (Mean ± S.D.)</th>
<th>Behavior (Mean ± S.D.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>3.303 ± 1.536</td>
<td>3.947 ± 0.922</td>
<td>3.780 ± 1.121</td>
<td>3.588 ± 1.184</td>
<td>3.625 ± 1.108</td>
<td>3.780 ± 1.121</td>
<td>3.588 ± 1.184</td>
</tr>
<tr>
<td>Group 2</td>
<td>3.559 ± 1.368</td>
<td>4.147 ± 0.862</td>
<td>4.000 ± 0.976</td>
<td>3.882 ± 0.914</td>
<td>3.850 ± 1.003</td>
<td>4.000 ± 0.976</td>
<td>3.882 ± 0.914</td>
</tr>
<tr>
<td>Group 3</td>
<td>3.956 ± 1.057</td>
<td>4.183 ± 0.726</td>
<td>4.179 ± 0.740</td>
<td>4.201 ± 0.830</td>
<td>4.068 ± 0.752</td>
<td>4.179 ± 0.740</td>
<td>4.201 ± 0.830</td>
</tr>
<tr>
<td>Group 4</td>
<td>2.563 ± 0.718</td>
<td>3.375 ± 0.595</td>
<td>2.896 ± 0.393</td>
<td>2.863 ± 0.419</td>
<td>2.969 ± 0.419</td>
<td>2.896 ± 0.393</td>
<td>2.863 ± 0.419</td>
</tr>
<tr>
<td>Group 5</td>
<td>4.500 ± 0.707</td>
<td>4.875 ± 0.177</td>
<td>4.375 ± 0.884</td>
<td>4.100 ± 1.273</td>
<td>4.688 ± 0.442</td>
<td>4.375 ± 0.884</td>
<td>4.100 ± 1.273</td>
</tr>
<tr>
<td>Group 6</td>
<td>4.469 ± 0.633</td>
<td>4.531 ± 0.542</td>
<td>4.563 ± 0.547</td>
<td>4.400 ± 0.835</td>
<td>4.500 ± 0.513</td>
<td>4.563 ± 0.547</td>
<td>4.400 ± 0.835</td>
</tr>
<tr>
<td>Group 7</td>
<td>4.600 ± 0.894</td>
<td>4.500 ± 0.707</td>
<td>4.700 ± 0.671</td>
<td>4.280 ± 0.820</td>
<td>4.550 ± 0.758</td>
<td>4.700 ± 0.671</td>
<td>4.280 ± 0.820</td>
</tr>
<tr>
<td>F</td>
<td>3.208*</td>
<td>1.910</td>
<td>3.345*</td>
<td>3.506*</td>
<td>3.429**</td>
<td>3.345**</td>
<td>3.506**</td>
</tr>
</tbody>
</table>

Scheffe test

*: Correlation is significant at the 0.01

(1) prefer single player games; (2) prefer limited multiplayer games; and (3) prefer full function multiplayer games

Students spend time in playing computer games. Some of them spend less than two hours daily averagely and some may spend more than four hours a day. We divide the student responses to five groups according to how much time students spend on playing computer games daily. The five groups are: playing no computer game (8.3%), playing computer games less than 2 hours (33.5%), playing computer games 2 to 4 hours (25.7%), playing computer games 4 to 6 hours (12.8%), and playing computer games more than 6 hours (19.7%). The differences that students in different groups may have are also investigated in this research. Table 11 lists the results of comparing different group students' CGAS responses with ANOVA and the Scheffe tests. All of the factors and subscales have significant differences among the groups with level 0.01. Moreover, the Scheffe tests show that students spending more time in playing computer games may have higher score in Computer Game Attitude Scale.
Table 11: Students who spend different time daily in playing computer games have different responses toward the revised Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Group</th>
<th>CON</th>
<th>LRN</th>
<th>LIKE</th>
<th>LEI</th>
<th>Cognition</th>
<th>Affection</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>not playing</td>
<td>(1.632)</td>
<td>(0.879)</td>
<td>(1.287)</td>
<td>(1.158)</td>
<td>(1.073)</td>
<td>(1.287)</td>
<td>(1.158)</td>
</tr>
<tr>
<td>less than 2</td>
<td>(1.218)</td>
<td>(0.866)</td>
<td>(0.862)</td>
<td>(1.053)</td>
<td>(0.915)</td>
<td>(0.862)</td>
<td>(1.053)</td>
</tr>
<tr>
<td>hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 to 4 hours</td>
<td>(1.061)</td>
<td>(0.723)</td>
<td>(0.677)</td>
<td>(0.833)</td>
<td>(0.718)</td>
<td>(0.677)</td>
<td>(0.833)</td>
</tr>
<tr>
<td>4 to 6 hours</td>
<td>(0.826)</td>
<td>(0.665)</td>
<td>(0.800)</td>
<td>(0.788)</td>
<td>(0.672)</td>
<td>(0.800)</td>
<td>(0.788)</td>
</tr>
<tr>
<td>more than 6</td>
<td>(0.965)</td>
<td>(0.705)</td>
<td>(0.837)</td>
<td>(0.735)</td>
<td>(0.698)</td>
<td>(0.837)</td>
<td>(0.735)</td>
</tr>
<tr>
<td>hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheffe test</td>
<td>(3)&gt;(1)</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(3)&gt;(1)</td>
<td>(3)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(5)&gt;(1)</td>
</tr>
<tr>
<td></td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(3)&gt;(2)</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(3)&gt;(2)</td>
<td>(5)&gt;(1)</td>
</tr>
<tr>
<td></td>
<td>(5)&gt;(1)</td>
<td>(3)&gt;(2)</td>
<td>(5)&gt;(2)</td>
<td>(5)&gt;(2)</td>
<td>(3)&gt;(2)</td>
<td>(5)&gt;(2)</td>
<td>(5)&gt;(2)</td>
</tr>
</tbody>
</table>

*: Correlation is significant at the 0.01

We also further investigate whether or not the time spent on playing computer games during weekdays and weekends have influence to the students' CGAS responses. During weekdays, there are 31.2% of students who do not play computer games, 38.5% of students spend less than 2 hours in playing computer games, 14.7% of students spend 2 to 4 hours in playing computer games, 7.3% of students spend 4 to 6 hours in playing computer games, and 8.3% of students spend more than 6 hours in playing computer games. Table 12 list the results of ANOVA and the Scheffe's tests. The results show that there is no significant difference in the responses to the Learning factor among groups. The Scheffe tests also show that less significant patterns among groups have found. However, in general speaking, the hardcore players do still have higher CGAS value than non-players (i.e., who play no computer games all the time no matter in weekdays or weekends) and leisure game players (i.e., who play computer games less or even not during weekdays but will play less than 2 hours or more in weekends).

For weekends, there are 22.9% of students who do not play computer games, 26.1% of students spend less than 2 hours in playing computer games, 17% of students spend 2 to 4 hours in playing computer games, 13.8% of students spend 4 to 6 hours in playing computer games, and 20.2% of students spend more than 6 hours in playing computer games. From the results of ANOVA and the Scheffe's tests listed in Table 13 we can see that all of factors and subscales have significant difference among the groups.
### Table 12: Students who spend different time daily (during weekdays) in playing computer games have different responses toward the revised Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Group</th>
<th>CON</th>
<th>LRN</th>
<th>LIKE</th>
<th>LEI</th>
<th>Cognition</th>
<th>Affection</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mean)</td>
<td>(SD)</td>
<td>(mean)</td>
<td>(SD)</td>
<td>(mean)</td>
<td>(SD)</td>
<td>(mean)</td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not playing</td>
<td>3.371 (1.331)</td>
<td>3.989 (0.798)</td>
<td>3.771 (1.055)</td>
<td>3.73 (1.09)</td>
<td>3.682 (0.949)</td>
<td>3.771 (1.055)</td>
<td>3.73 (1.09)</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 2 hours</td>
<td>3.628 (1.224)</td>
<td>4.012 (0.82)</td>
<td>3.976 (0.742)</td>
<td>3.805 (0.956)</td>
<td>3.818 (0.892)</td>
<td>3.976 (0.742)</td>
<td>3.805 (0.956)</td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 to 4 hours</td>
<td>4.359 (0.842)</td>
<td>4.32 (0.744)</td>
<td>4.292 (0.753)</td>
<td>4.166 (0.907)</td>
<td>4.341 (0.615)</td>
<td>4.292 (0.753)</td>
<td>4.166 (0.907)</td>
</tr>
<tr>
<td>Group 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 to 6 hours</td>
<td>4.531 (0.712)</td>
<td>4.505 (0.597)</td>
<td>4.281 (0.917)</td>
<td>4.388 (0.659)</td>
<td>4.515 (0.618)</td>
<td>4.281 (0.917)</td>
<td>4.388 (0.659)</td>
</tr>
<tr>
<td>Group 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than 6 hours</td>
<td>4.556 (0.942)</td>
<td>4.208 (0.871)</td>
<td>4.653 (0.67)</td>
<td>4.789 (0.533)</td>
<td>4.382 (0.679)</td>
<td>4.653 (0.67)</td>
<td>4.789 (0.533)</td>
</tr>
<tr>
<td>F</td>
<td>8.112**</td>
<td>2.338</td>
<td>5.046**</td>
<td>6.168**</td>
<td>6.910**</td>
<td>5.046**</td>
<td>6.168**</td>
</tr>
<tr>
<td>Scheffe test</td>
<td>(3)&gt;(1)</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(2)</td>
<td>(3)&gt;(1)</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(2)</td>
<td></td>
</tr>
</tbody>
</table>

*: Correlation is significant at the 0.05
**: Correlation is significant at the 0.01

### Table 13: Analysis of average hour of daily game play in weekend and Computer Game Attitude Scale.

<table>
<thead>
<tr>
<th>Group</th>
<th>CON</th>
<th>LRN</th>
<th>LIKE</th>
<th>LEI</th>
<th>Cognition</th>
<th>Affection</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mean)</td>
<td>(SD)</td>
<td>(mean)</td>
<td>(SD)</td>
<td>(mean)</td>
<td>(SD)</td>
<td>(mean)</td>
</tr>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not playing</td>
<td>3.305 (1.323)</td>
<td>3.825 (0.708)</td>
<td>3.615 (0.976)</td>
<td>3.525 (0.92)</td>
<td>3.568 (0.883)</td>
<td>3.615 (0.976)</td>
<td>3.525 (0.92)</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>less than 2 hours</td>
<td>3.272 (1.083)</td>
<td>3.904 (0.766)</td>
<td>3.73 (0.761)</td>
<td>3.597 (1.016)</td>
<td>3.588 (0.788)</td>
<td>3.73 (0.761)</td>
<td>3.597 (1.016)</td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 to 4 hours</td>
<td>3.696 (1.313)</td>
<td>4.088 (0.93)</td>
<td>4.187 (0.888)</td>
<td>4.041 (1.051)</td>
<td>3.887 (0.97)</td>
<td>4.187 (0.888)</td>
<td>4.041 (1.051)</td>
</tr>
<tr>
<td>Group 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 to 6 hours</td>
<td>4.5 (0.785)</td>
<td>4.408 (0.73)</td>
<td>4.425 (0.686)</td>
<td>4.187 (0.832)</td>
<td>4.452 (0.579)</td>
<td>4.425 (0.686)</td>
<td>4.187 (0.832)</td>
</tr>
<tr>
<td>Group 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>more than 6 hours</td>
<td>4.648 (0.767)</td>
<td>4.479 (0.694)</td>
<td>4.523 (0.715)</td>
<td>4.696 (0.54)</td>
<td>4.564 (0.604)</td>
<td>4.523 (0.715)</td>
<td>4.696 (0.54)</td>
</tr>
<tr>
<td>Scheffe test</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(4)&gt;(1)</td>
<td>(5)&gt;(1)</td>
<td>(4)&gt;(1)</td>
</tr>
</tbody>
</table>

**: Correlation is significant at the 0.01

### 5. Conclusion

This paper aims to provide researchers and teachers a valid and reliable revised Computer Game Attitude Scale which can be used even by children at their age of seven. Moreover, the findings of the differences among gender, grade, preferred gaming way, and game play experience, show that educational games may be appreciated by elementary school students and hardcore game players. Students who prefer to play full function multiplayer games seem to be more positive toward the idea of...
learning from playing computer games. In the other words, an educational game may have higher usability and be accepted by students if it can have well-designed multiplayer functionality built-in.

References


Why Are Schools Reluctant to Bring Higher-order Thinking Games to Classrooms?

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mingfongjan@gmail.com

Abstract: In this conceptual paper, we analyze why schools are reluctant to bring higher-order thinking games to the classrooms. We use a role-playing mobile game designed for scientific argumentation—Mad City Mystery—to illuminate the complexity of the issue. We argue that the complexity arises at the design level, at the enactment level, and at an education system level as schools evaluate bringing a higher-order thinking game to a classroom. We maintain that these factors, as synthesized in Table 1, can be utilized as an essential check list for researchers, teachers, school leaders and policy makers when they consider designing and introducing higher-order thinking games to the classrooms.

Keywords: game-based learning, scientific argumentation, school innovation, ICT integration, 21st century competency

1. Games for learning: Promise and reality

Game-based learning surfaces as a promising solution to educational reform, especially for developing 21st century competencies (Shaffer, Halverson, Squire, & Gee, 2005). Indeed, game scholars in the 20th century did not miss the connection between games and learning. MIT researcher Malone (1980) was one of the pioneers to theorize the motivation aspects of game play and learning. Using games, or the concept of games, as learning approaches, however, did not gain momentum until Prensky and Gee. Prensky (2001) maintains that games motivate learners to learn deeper with its player-centered design. Gee (2003, 2007), arguing from a sociocultural perspective, maintains that “good” games can help people learn because they incorporate learning theories and cultural models. With the promotion and theorization from heavyweight scholars, game-based learning has become a popular research theme in the past decade.

Researchers are not the only ones intrigued by the mysterious power of games. While researchers are designing and theorizing games for learning, school practitioners in many parts of the world have already used games for learning in classrooms. In a 2011 survey by the Joan Ganz Cooney Center (Barseghian, 2012), 18% of the 505 K-8 United States teachers (mostly K-5th grade) use games in their classroom on a daily bases while half of them use digital games with their students two or more days a week. Nearly 70% of the participant teachers said that “lower-performing students engage more with subject content with use of digital games.”

In Asian countries such as Singapore, games emerge as an attractive approach for teaching and learning. In the Ministry of Education, a special task force is dedicated to game-based learning. Schools not only work with researchers to develop learning games (e.g., Jan, Chee, & Tan, 2010), but also utilize commercial off-the-shelf game engines and editors to design their own games for learning (e.g., “3DHive - Canberra Primary School,” 2014).

Given the zeal in game-based learning across international boundaries and stakeholder communities, there are few reported cases in Asian schools that utilize games for higher-order thinking (e.g., Squire & Barab, 2004), place-based inquiry (e.g., Klopfer, 2008), scientific habit of mind (e.g., Steinkuehler & Duncan, 2008) or scientific argumentation (Squire & Jan, 2007)—all of them are higher-order thinking skills that can be viewed as 21st century competencies. While game scholars are urging schools to utilize games for deep learning (e.g., Gee, 2003), identity formation (e.g., Thomas & Brown, 2009), and even changes of discourse patterns in the classroom (e.g., Jan, 2010), schools are mostly using games for motivation, drilling and practices (Jan, 2013). Even when they use games for learning, it is rarely a sustainable practice (e.g., Chee, Tan, Tan, & Jan, 2012).
2. Why Are Schools Reluctant to Bring Higher-order Thinking Games to Classrooms?

Since games are a popular medium for learning and game-based learning is a proven approach for developing higher order thinking skills such as historic thinking and argumentation, why are schools reluctant to bring higher-order thinking games to classrooms?

This conceptual paper provides an analytic account for the above phenomenon. In particular, we tease out the major reasons that keep researcher-developed higher-order thinking games out of schools. To illustrate the case, we use Mad City Mystery (will be referred to as MCM hereafter), a scientific argumentation game designed by researchers (Squire & Jan, 2007), as an example to delineate pertinent issues that inhibit using games for higher order thinking skills in classrooms.

As a conceptual paper, this paper does not employ a standardized research paper structure commonly found in empirical studies. Instead, we describe the problem and build the argument with an authentic example—MCM. As the game designer and co-researcher of this game, I describe the game design and critical elements that enable the game a success in engaging students to practice scientific argumentation. After that, we re-situate the enablers in the classrooms in order to illuminate why schools may not utilize the game as it is. A similar writing approach is commonly adapted by education researchers such as the conceptual paper by diSessa and Cobb (2004) at the Journal of the Learning Sciences.

3. Case Selection Criteria

Why do we choose MCM to illuminate the issues pertaining to bringing higher-order thinking games to schools? Mad City Mystery (Squire & Jan, 2007), a role-playing mobile game designed to foster scientific argumentation skills by designing an authentic argumentation context, is an early proof of concept in game-based learning. It exemplifies how game-based learning may engage players in making scientific argumentation—a higher order thinking skill. The following reasons justify the case selection.

1) MCM is designed for a higher-order skill that is relatively common in the school syllabus. The curricular alignment makes it a plausible choice for schools to take up. The alignment with the science curriculum enables us to scrutinize reasons for not taking up the game.

2) A robust proof of concept is an important factor for schools to take up a learning game. MCM has clearly demonstrated the potential of game-based learning for a higher-order thinking skill.

3) The technology that enables MCM was novel when it was developed, but has become mature and readily available in the past few years.

The above criteria make MCM a plausible choice when schools consider using a learning game to foster scientific argumentation. In using MCM to make a case, we are able to exclude three major reasons that often prevent teachers from using a new technology in their classroom: curricular alignment, proof of concept, and technology integration (e.g., Cuban, 1986; Earle, 2002). In other words, the choice of the case enables us to highlight other factors that are equally critical, but often inconspicuous when it comes to bringing higher-order thinking games to classrooms.

4. MCM: A game-based learning model for scientific argumentation

MCM is a mobile game designed by researchers for scientific argumentation. With a location-sensitive technology developed by MIT (Klopfer, Squire, & Jenkins, 2004), Squire and Jan turned the physical space into an enormous game board. They employed game design principles such as role-playing, open-ended challenges, rich just-in-time contents delivery, to design a location-based game. Players role-play as teams of Environmental Specialist, Medical Doctor and Government Official. In uncovering the mysterious death of Ivan, they interview non-player characters (NPCs)
to collect qualitative and quantitative data. The data is designed based on argumentation theory such as Toulmin’s (1958) argumentation pattern. The ultimate goal is to design an authentic context in the game so that it is essential for players to coordinate theory and evidence (Kuhn, 2005) while they investigate the mystery. The coordination of theory and evidence, based on Kuhn, is the core skill of scientific argumentation.

4.1 Briefing Session

The entire learning activity is composed of three activities that can be completed in 2~3 hours: pre-game briefing, gameplay, and post-game debriefing. The pre-game debriefing familiarizes players with the game narrative, game interface and technology. Game play was initiated after the briefing when a team of three players (as a Medical Doctor, a Government Official and an Environmental Scientist) read about Ivan’s death from their GPS-enabled mobile device.

4.2 Game Session

Ivan Ilyich is dead.
Police claimed that he drowned while fishing by the south shore of Lake Mendota.
Between January and the time of his death, Ivan put on 25 pounds and started drinking heavily. His health condition had deteriorated considerably.
As one of his friends, your task is to investigate the case with two of your best friends. It is your duty to present a clear picture about the causes and effects of these to the public.

The investigation of Ivan’s mysterious death brought the team (composed of three players) into a complex system involving ecological, social, and cultural issues in Ivan’s case. The success of the investigation relies on the players’ ability to (1) critically filter the data they receive from the non-player characters (NPCs) in the game, (2) formulate hypotheses based on the collected data, and (3) revise/abandon hypotheses or construct new hypotheses when new data emerge. Through the entire game, players are immersed in (1) data collection at different physical locations and (2) the practices of coordinating theories and evidence. Figure 1 demonstrates how the non-player characters are designed to foster the argumentation among the players.

![Figure 1: Designing non-player characters to foster the coordination of theory and evidence](image-url)
Furthermore, the coordination of theories and evidence is a collaborative effort by design. Each player, depending on the role they play, only receives a subset of data. Unless they work with each other closely, each player can only develop a partial view of Ivan’s case. In this process, team building is as critical as theory building if they want to solve the mystery.

During the game play, player teams often play at different paces due to various factors—collaboration skills, computer literacy, reading capabilities, observation of the physical space, to name just a few. Therefore, almost no teams finish the game at the same time.

At the end of the data collection, players need to ask more questions because the game never gives students sufficient data to come up with an absolute answer. The design goal is for them to develop multiple hypotheses and tell people which ones are more plausible. This is similar to multiple interpretations and debates about the extinction of dinosaurs in the science community.

4.3 Debriefing Session

In the debriefing session, players are first given thirty minutes to examine collected data and develop hypotheses as teams. After that, each team present their case to the Chief Investigator played by a researcher. What happened to Ivan Ilyich? How did he die and why should it be a concern to the public?

_MCM_ was designed to with open-ended challenges—there are no “absolutely correct” answers that student players can identify in a content mastery paradigm. Players’ performance is evaluated based on how well they are able to piece together relevant data and formulate evidence-based and plausible theories. The debriefing to the Chief Investigator is the assessment on the players. After the assessment, players are encouraged by the Chief Investigator to reconsider how they may come up with more robust theories or hypotheses about the above questions based on the collected data.

In a nutshell, _MCM_ provides a designed experience (Squire, 2006) that is informed by theories about learning argumentation. The play experience is similar to the discourse practice commonly found in scientists’ communities (c.f., Lemke, 1990; Gee, 2004)—debating the validity of data, making hypotheses, revising theories, and reporting findings.

4.4. Designing Argumentation Experience in Out-of-school and School Settings

_MCM_ successfully create a designed experience where players develop argumentation skills via authentic discourse practices (e.g., Lemke, 1990) in an out-of-school setting. What does it take to bring _MCM_ to schools so that a similar designed experience can be achieved? This is a question that we ask in the beginning of this paper. This is also a question that policy makers, school leaders, and teachers are most concerned about when they consider introducing learning games to the classrooms.

To unpack the question, we examine the critical design elements that enable the designed experience mediated by _MCM_ in an out-of-school context. We then ask if the critical design elements can be replicated regularly in schools so that a similar designed experience can be achieved. Examining the efforts that it takes to bring _MCM_ to the classroom enables us to pinpoint a set of critical design constraints that researchers, teachers, school leaders and policy makers should consider if the ultimate goal of designing a learning game and activities is to generate sustainable impacts to student learning in a school setting.

5. Critical Design Elements that enable _MCM_ as a game for scientific argumentation

In the following, we enlist the critical design elements for _MCM_ and re-situate them in a classroom setting. Doing so allow us to identify and examine the enablers for both contexts. Specifically, we will unpack these critical design elements from the (1) game design stage to the (2) game enactment stage in order to develop a systematic understanding.

5.1 Critical Design Elements in the Game Design Stage
In the game design stage, the critical design elements that enable the success of MCM are:

1) **Designing a learning experience that is informed by learning theories.** Integrating learning theories that inform how people develop argumentation in situ and game design principles are the most challenging design components in MCM. The designers of MCM not only design the game, but also the theory-informed play experience. To ensure a similar designed experience for scientific argumentation in the classroom, there is a need for teachers to be able to play a similar role that the researchers played—understanding the affordances of MCM and how to leverage its affordances for argumentation skills (Jan, 2009). Unfortunately, teachers are mostly trained as content experts rather than experience designers or facilitators. Besides, the role change will have a deep effect on classroom management, discourse participation (e.g., O’Connor, & Michaels, 1996; Jan, 2009), teacher-student relationship (e.g., Frymier, & Houser, 2000) and other unexpected outcomes that teachers must be prepared for.

2) **The availability and affordability of technology.** The design of MCM was enabled by MIT’s mobile augmented reality game engine/editor (Klopfer & Squire, 2008). The software technology and the digital device are critical enablers for a game like MCM. Though the technologies were not commonly seen in schools at the time MCM study was carried out, it has become mature and the infrastructure is in place for most schools in developed and some developing countries. In Singapore, many schools are currently using similar technology to develop learning trails for history, science and other subjects (e.g., So, Kim, & Looi, 2008). Even without the game engine/editor provided by MIT, there is a great chance that MCM can be reproduced using game engines available today. The real challenge, however, may not lie in the price tag. Whether the devices are easy to maintain and if the devices are used for multiple purposes are all practical issues that schools and policy makers must put into consideration.

3) **Flexibility in designing learning objectives and curricular structure.** MCM was designed for students to develop scientific argumentation skills—important 21st century literacy. As MCM was designed, the researchers were more concerned about the proof of concept. Designing a learning program not bounded by the formal school curriculum is a more feasible choice at a proof-of-concept stage. To bring MCM to the classroom, we must at least consider the following schooling-related constraints. The first and foremost is if developing scientific argumentation skill is a requirement in the curriculum. Even with scientific argumentation listed as an important learning objective, there is the issue of teaching approach and time allocated for developing argumentation skills. Fostering students’ scientific argumentation skills require substantially more time than teaching what a scientific argumentation is using a direct instruction approach. In a content mastery learning paradigm, taking more time for the practices of scientific argumentation means less time for other content areas and therefore unexpected consequences if not planned well.

4) **Flexibility in choosing the learning sites.** To make MCM an authentic life experience game, the researchers utilize GPS-enabled technology to develop scientific argumentation skills. In MCM, the choice of game site is not a random choice because the problems players encounter in the game are also authentic problems commonly identified in the same physical space. Learning in the mainstream classrooms often assumes that learning in contexts (e.g., place experience) can be traded for convenience and efficiency (i.e., content mastery). To create a similar experience in schools, there is a need to “localize the game” based on the schools’ location and the authentic problems to be solved near that location. This may post a tremendous challenge to schools if the goal is to recreate a similar authentic learning experience.

5) **Flexibility in designing alternative assessment.** In MCM, assessment is designed as students’ team performance in the debriefing session. The goal is to identify the failure or mistakes that players make so that appropriate scaffolding can be provided. Players’ performance is evaluated based on how they defend their hypotheses about Ivan’s death. From there, the researchers could understand players’ needs in
developing scientific argumentation skills. In other words, the assessment is designed to improve learning. In schools, assessments are often designed for multiple purposes. Unfortunately, many assessments, especially high-stake exams, are designed for streaming and ranking. Ranking students are so important that there is often a demand for new learning programs to have a quantifiable assessment before schools adapt them.

5.2 Game Enactment Stage

In the enactment stage, the critical design elements that enable the success of MCM are:

1) **Administrative and logistic support.** Before running the MCM game, there is a need to install software to all mobile devices, manage their updates, and make sure that they are all charged for game play. This is not a trivial task when there are 30~40 mobile devices to manage. When students play the game in an outdoor space, players’ safety is always a concern especially for young kids who are concentrated on the mobile device. For a classroom with 40 students, there is a need to deploy 4~6 well-trained teachers to help manage game play during its enactment.

2) **Roles and social model.** MCM is a role-playing game with a unique social model designed into the practices of scientific argumentation. To play the game is to enact the embedded social model. It requires students and researchers to play roles that are quite different from their everyday identities. To enact the social model in a classroom, there is a need for the students to view themselves as professionals and inquirers. Shifting their identity from a student to a professional ensures the learning process to be more authentic. The identity shift can not be achieved without the researchers playing a counterpart. Creating a social model and fostering such an identity shift is perhaps more challenging in the classroom than in an outdoor space due to the established cultural model (e.g., Wegerif, Mercer, & Dawes, 1999) in the mainstream classrooms.

3) **Diverse learning pace.** To make MCM a successful learning experience, the research team allows the players to play at their own comfortable pace based on their needs and capabilities. Players interested in knowing more about water quality may spend more time observing water by the lake. Players who like to share may raise more questions when they collect new evidence. It is often not the case in a mainstream classroom, especially when developing cognitive abilities are placed on top of the learning hierarchy. Most classrooms have troubles accommodating students with diverse learning paces, not to mention diverse learning needs. This phenomenon has not changed much since Dewey (1956) comments on the compartmentation of subjects and grades in schools.

Table 1 summarizes the critical design elements for MCM and what it takes to enable them in schools.

<table>
<thead>
<tr>
<th>Critical Design Elements</th>
<th>Challenges in bringing MCM to schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Designing a game that is informed by learning theories.</td>
<td>Teachers are often trained as content experts and they mostly utilize direct instruction as a major pedagogical approach. To enact MCM, teachers need to understand how scientific argumentation skills are developed and play a mentor/facilitator role in guiding students. There is a need for professional development in the above areas.</td>
</tr>
<tr>
<td>2. The availability and affordability of technology</td>
<td>Although the technology that enables MCM is mature and affordable today, there is a need to consider if the technology is useful for other purposes and is easy to maintain.</td>
</tr>
</tbody>
</table>
3. Flexibility in designing learning objectives and curricular structure.  Developing higher order thinking skills requires guided participation through authentic practices. It takes significantly more time to develop. This creates a tension for a curriculum designed for teaching scientific argumentation instead of practicing argumentation.

4. Flexibility in choosing the learning sites.  *MCM* is designed based on problems authentic to the place where it is played. There is a need to localize the game at a different site in order to recreate similar authentic learning experience.

5. Flexibility in designing alternative assessment.  In *MCM*, the assessment is designed to help the researcher address issues of learning. In schools, assessments are often designed with ranking as the top priority. To design an assessment for learning and ranking at the same time is complex, and is often not achievable.

6. Administrative and logistic support.  Using digital technologies to support learning demands tremendous amount of administrative and logistic support. Given that resources are always limited, there is a risk of enabling *MCM* in schools at the price of other learning activities.

7. Roles and social model.  The researchers design a new social model to foster scientific argumentation. It can be a daunting challenge to promote this new social model in a classroom when there is already an established social model.

8. Diverse learning pace.  Schools demand students to learn with similar speed/pace, and the mainstream curriculum is designed with this assumption. Therefore, catering the needs of learners with diverse learning styles will be a critical concern for the game to be used in schools.

6. Why are schools reluctant to bring higher-order thinking games to the classrooms?

Based on the above analysis, we can further delineate the issues of bringing a game like *MCM* to the classroom in three areas—curricular, teaching and managerial. Curricular issues refer to structural issues such as what to teach and how much time is allocated for teaching a topic. It is within the same category that the purposes of assessment are defined. Teaching issues refer to what teachers learn when they learn to teach and how they actually teach in the classrooms. Managerial issues refer to how resources are allocated to keep the system effective, such as teacher/student ratio, and the support given to teachers for teaching a subject. We find that in enabling *MCM* as a sustainable practice, all of the above practices face significant challenges. In a nutshell, there is misalignment lying at the system level if we wish to promote higher order thinking skills with games like *MCM*.

6.1 How should the analysis be interpreted?

In presenting these design challenges or design constraints, we do not maintain that higher order thinking games can be introduced in the classrooms because it requires substantial changes at a curricular, teaching and managerial level to sustain the MCM learning practices. We do not argue that we should keep the current education system intact because the price to pay is too great to be practical. We ask readers not to view the condition as a dualistic choice. Rather, the case presents a comprehensive view of the issues and complexities in introducing a higher order thinking game to the classroom. The complexity arises at the design level, at the enactment level and at a system level because the issue is not as simple as bringing a higher-order thinking game to a classroom. If fostering higher-order thinking skills is essential for a flat new world (Friedman, 2006; Shaffer & Gee, 2005), then there is a need to reconsider the major design assumptions underlying the current education system and why it is resilient to changes (Sarason, 1996).
6.2 How may the analysis inform practitioners and researchers when they bring/design higher order thinking games for sustainable changes?

We argue that the analysis above can also be viewed as an essential checklist for, teachers, school leaders, and policy makers when they consider bringing higher-order thinking games or other learning technologies to the classrooms. For researchers, this list will inform them to better define the design constraints if the ultimate goal is to bring their learning design to the classroom on a regular basis. For instance, the researchers may design card games informed by the MCM design principles as a way to minimize the pushbacks from the established learning system. It is useful for teachers to interrogate the changes they might have to make and the professional development they must go over before they take on this journey. School leaders and policy makers have more authority to redefine the constraints at different levels. Without fundamentally changing the education system, they could create alternative spaces within the system to slowly, but firmly and steadily, roll in new learning initiatives.

7. Contribution

This paper explicates the challenges and constraints of bringing higher order thinking games to schools from a design perspective. We scrutinize eight design constraints arising due to the change of design contexts—from an out-of-school setting to the mainstream schools—and the change of design objectives—from a proof of concept to everyday practices. By doing so, our contribution to the research community and stakeholders can be summarized as:

1) Presenting a holistic and comprehensive picture about the design constraints that game-based learning researchers must identify before they embark on designing learning games. There are researches that zoom into certain design constraints from different perspectives such as technology integration (e.g., Chai, Koh, & Tsai, 2010). Viewing from a design perspective enables the researchers and practitioners to consider the design constraints simultaneously from multiple levels—cognitive processes, tools, social models and systems. We argue that viewing these design constraints as a holistic and interwoven mechanism is a major contribution of this paper.

2) We explicate how “context” plays a critical role in designing games for learning. Our analysis highlights the design of a small “g” game and big “G” game at the same time. Drawing from Gee (2008), good game designers not only design the small “g” game—the software—but also the big G game—the social interaction taking place when the small “g” game is played. To play MCM in an out-of-school setting and schools, the same “g” game is identical while the big “G” game is different. This paper spells out some major factors that define the big “G” game in the mainstream schools.

8. Limitation

In crafting this conceptual paper with a case—MCM, we do not argue that all higher order thinking games will face identical design constraints when they are used in schools. Undeniably, a card game designed based on the same design principles may encounter different constraints. Nonetheless, there are system level constraints—such as teachers’ capacity—that are shared regardless the choice of media. We hope that there will be more studies about design constraints at different school systems. The better we are able to clarify the design constraints, the better we can pinpoint key design features at the early development stage.
References


An RPG Pattern for Ethical Gameplay in MAGNITUDE

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Abstract: Disaster response works usually contain many problems, which need to be solved immediately. Most of such problems are consisted ethical matters. Therefore, it is essential for disaster responders having an awareness of ethical consideration to make decision accurately. To address such requirement, we designed a training game environment named MAGNITUDE. The game was proposed to improve non-technical skills, i.e. ethical decision-making. MAGNITUDE combined two types of game genre, simulation and role-playing game (RPG). By implementing simulation genre, it is expected to provide realistic-situation like disaster response. Whereas, by adopting RPG genre, we presume that MAGNITUDE encourage a player to increase the level of his/her non-technical skill from a novice to an expert. In this paper, we explain the RPG pattern, which yields the ethical gameplay implemented in MAGNITUDE game.

Keywords: RPG Pattern, Ethical Gameplay, Ethical Dilemmas, Training Game, Simulation and Role-Playing Game.

1. Introduction

Disaster response works require personal skills in project management, teamwork, effective communication, and other soft skills. The disaster responder, therefore, should increase their soft skills regularly. However, it is difficult to create a realistic exercise due to limited environment. Training game is an approach to deal with the above issue. Researchers in this area found that games have the potential to enhance the training and performance of a disaster response team. Training games may improve the emergency team skill by providing regular training opportunities (Hullet & Mateas, 2009). The idea of enabling games as tools for education and training is not new. With decades of researches on game for learning, the games were usually developed for specific learning outcome, for example the games for emergency rescue and evacuation, emergency preparedness, and decision making (Campbell & Weaver, 2013). Training games takes benefits of gaming technologies for motivating, and interactive virtual learning environment that stimulates situated experiential learning.

The aim of this paper is to describe an RPG pattern in MAGNITUDE. Magnitude is a terminology to measure the earthquake scale. We named the game as MAGNTUDE, because we expect that the game can explode the player skill from a novice to be an expert. The game situates the natural post-disaster environment. It is intended to promote the player to have awareness of post-disaster setting and ethical tension appeared in such disaster response works. The structure of the discussion in this paper is as follows: In section 2, we firstly review the previous works concerning to the ethical model and game narrative. These works discovered that embedding ethical values into gameplay in MAGNITUDE is meaningful for encouraging the players to be aware of the real post-disaster situations. Section 3 explains the RPG design pattern. There are many patterns presented in the success commercial RPG, but we only discuss the specific patterns, which are suitable for ethical gameplay. We also discuss about a quest pattern in MAGNITUDE for transforming ethical values and judgment framework for assessing ethical decision. In section 4, we continue to discuss implementation of the proposed pattern. We finally conclude this paper in section 5.

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2. Previous Work

2.1 Ethical Model in MAGNITUDE

Social and humanitarian action, such as emergency response of natural disaster, usually faces many problems. However, decisions made on a moral basis may have critical impacts on the societies. Ethics has been defined as the study of the general nature morality and the specific moral choices to be made by a person. Schreiber stated:

“Ethics refers to the study of systems of rules which are used to distinguish “right” actions—those which are ethical, moral, and valuable—from “wrong” actions. These systems are referred to as ethical systems, while specific rules that comprise an ethical system are called ethical principles” (Schreiber, Cash, & Hughes, 2011).

To embed ethical values, we pick up six components of moral intensity discovered by Jones, i.e. Magnitude of Consequence, Social Consensus Probability of Effect, Temporal Immediacy, Proximity, Concentration of Effect (Lincoln et al., 2011). We previously studied the model of game elements to implement them in MAGNITUDE (Wahyudin, Hasegawa, & Dahlan, 2013). Figure 1 shows the relationship between ethical components and others.

The following are MAGNITUDE elements. Some of them contain specific components of moral intensity:

a) Victim Information is complete data, including the number of victims, illness involved, and social background. This element contains Magnitude of Consequence and Proximity. Knowing information of victims is necessary for the player to distinguish the victims who need immediate help or not.

b) Disaster Information is data about the type, scale, and location of the disaster. Situation awareness is knowledge of the circumstances that will occur later. The elements consist of Probability of Effect, Concentration of Effect and Temporal Immediacy. By having an awareness of disaster situation, the player can estimate that the actions in disaster response are potential to affect the environment or community in short or long time span.

c) Commander Directions are all advices from the disaster response commander related to the response stages. The commander has a duty to manage and direct the process of response. It is important to keep the process on the track of the actions plan, because the longer the process goes, the more difficult the commander sets up the next step.

d) Teammate Opinions are comments or judgments from the other members of the team. As part of social collaborative teamwork, each member of the disaster response team has own rational thinking. Some of them have supporting argument, whereas the others dispute the player’s analysis.

e) Public Opinions are comments and responses come from community and the victims to the action that has been carried out.

Commander Directions, Teammate opinions, and Public Opinions are MAGNITUDE elements, which contain Social Consensus.
2.2 Narrative of MAGNITUDE

MAGNITUDE is a game based training, which combined two genres of game, i.e. simulation and RPG. By implementing simulation, it provides the real-life disaster environment, such as flooding, earthquake, volcano eruption, and landslide. On the other hand, some literatures discovered that RPG is potential for teaching ethics and it can provide comprehensive ethical gameplay (Simkins, 2010). By incorporating RPG genre stimulate them to choose the best choice among ethical dilemmas that have emerged.

![Figure 2. Model of MAGNITUDE Narrative](image)

The main purpose of MAGNITUDE is to improve the skill level of the player from the novice to the expert. It takes place in the situations of post disaster, which player role is a member of a certain disaster response team (Wahyudin & Hasegawa 2014). Figure 2 illustrates the flow of the MAGNITUDE narrative. The game starts with an initial condition. Initial point demonstrates the opening narrative that shows the main character profile and roles. Each level contains branching narratives formed by four quests, which represent the types of disaster.

3. RPG Pattern

3.1 Applicable RPG Pattern

There are a lot of common patterns discovered from established RPG genre. However, in this paper we explain only the necessary patterns needed in MAGNITUDE. The followings are applicable patterns of RPG.

3.2 Character

A character is the game personality. The character may either controlled by the player, or by the computer. The character has characteristics, such as age, gender, strength, etc. that differentiates one by one. In a specific purpose, the character in MAGNITUDE can be classified into two classes, these are:

*Classes of character based on type*

- **Player Character (PC):** A PC in MAGNITUDE is named Pandu, which mean a boy scout. He is a teenager and a student in high school. He becomes an active student after joining a student organization at his school, which focuses on outdoor and humanitarian activities.
- **Non-player character (NPC):** NPC types can be distinguished into two categories. First NPC type is an interactive character, for example victim’s family, and basecamp commander. Interactive character has the big contribution to present ethical tension and they will be involved in dialog trees. Another type is non-interactive character, with which the player cannot communicate with the others. Usually, non-interactive NPC is the only ornament for the game world.
**Classes of character based on behavior**

- **Protagonist:** This character has good behavior. The player usually acts as a protagonist.
- **Antagonist:** This character has bad behavior. Antagonist might come from the disaster response team or from the community. For instance, it always has a bad judgment to any actions taken by the player or annoys the main character actions.
- **Dynamic:** This character is usually an NPC appeared in all situations. In some situations the NPC expresses good behavior, but in another condition it conducts bad behavior or does not react anything to the main character.

### 3.3 Character Point

Character point is awarded to the player when he/she completes the quests, overcoming the obstacles. It is an incentive given to the player to encourage. It also performs the results of the activities’ appropriate acquisition parameters. Character point in MAGNITUDE is determined by a combination of the following factors.

- **Success reward:** It is an incentive given to the player to encourage him/her show up the period and success to pass the difficulty or solve the problem.
- **Social Reward:** It is an incentive given to the player when the NPC was satisfied with his/her act. If he/she does satisfied job, the NPC will give him/her one point of Social Reward and vice versa.
- **Failure Reward:** It is negative rating given to the player when he/she commit to a fatal mistake.
- **Teammate Reward:** It is a satisfaction of the disaster response team when the player shows good collaborative works.

### 3.4 Hit Points

Hit Point is also known as Health or Life. The player’s ones are status of the character’s health during disaster response works. Doing a lot of work, he/she will lose his/her Hit Points. If his/her Hit Points decreases, he/she needs to add source of energy or take an enough rest. It can be added by earning food items found in the game world. For the NPCs of the disaster response team, Hit Points will lead to the slow of their response, and it is related to the mood of those NPCs. For the NPCs of the victims, once Hit Points lost rapidly, it will affect loss of the opportunity to save their life.

### 3.5 Resources

Resources are properties with limited quantity in the game world that the player may get, manage and consume in certain ways. For instance, he/she should find food to keep the energy in sufficient level. He/she may fight with the bad NPC to obtain the food items so that he/she can assure that his/her energy is maintained. On the other hand, if he/she discovers the victims who need food items, he/she can expend the reserved foods to help the victims’ life.

### 3.6 Quest Pattern for Transforming Ethics Values

Quest provides the player with purpose and direction of the disaster response works. It also promotes him/her to explore the game world and make interaction with the NPC or static objects. The followings are typical patterns of RPG quest, which are possible to transform ethical values (Smith, 2011).

### 3.7 Actions

Actions are abstractions of the player’s steps to complete the quests. For example, a quest which pushes him/her to do search and rescue operation when a natural disaster strikes. The player should distinguish between injured victims and died victims. The injured victims have priority to be evacuated than died victims. The following are elements of quest actions applied in MAGNITUDE.
• Options: It is the element which, the player will be confronted with the ethical dilemmas. Every option has Type and Outcome. Type is the kind of being made by the player such as, amputated victim’s leg, destroyed hill, etc. Outcome is the result based on what the player opts.
• Equipment: It is a specific item needed to solve confronted problems. The variables of this element are the amount and function of them. For example, when the player discusses the response works, he/she will be asked to prepare safety equipment’s and should determine and gather the necessary equipment related to the type of disaster.
• Moxie: The element pushes the player to use his/her personal knowledge to attain the objectives. This is a very important element in MAGNITUDE, because it endorses him/her to use his/her skills for making decisions rather than just exploiting the virtual skills of his/her character.

3.8 Objectives

Objectives are tasks needed to solve to complete the quest. The player will be assigned the main objectives, such as, determining the type and scale of the disaster, preparing emergency equipment, collecting the food items, searching and evacuating the victims, gathering information, and making decisions when response actions faced the dilemmas.

3.9 Quest Structure

Quest Structure causes the actions and the quest merging together. In MAGNITUDE, Quest Structure consists of:
• Ethical Dilemmas: The player will be confronted with the problems of search and rescue activities. Every problem contains at least one of six components of moral intensity.
• Deadline: It is a set amount of time. The player should complete the quest before it mechanically ends. If he/she cannot complete such tasks in a particular time, he/she will get the false point and the quests will be marked as failed.

4. Example of MAGNITUDE Quest

An example quest takes place in the situation of flooding disaster. Figure 3 shows narrative for this quest. The quest starts with a narrative that explains the objective of the quest. He/she requested to meet a commander (interactive NPC), who will guide the discussion to plan disaster response. He/she asked about disaster type, location and scale of the impacted area, and the number of the victims. To do quick response, he/she needs to determine the priority area, which area is fatal destruction. On the other hand, he/she should measure the possibility to save as much as possible the victims in this area.

The player would continue to select priority of response actions. There are two jobs, i.e., caring the chilled elders, and evacuating the injured woman. In first location, there are many elders who need blankets and hot meals to prevent them from hypothermia. The problem is prepared blankets are not enough to meet the needs of all refugees. Some of the teens contend to get the blankets. Some of them have bad behavior that aggressive to annoy the player’s act. However, if
he/she meets the teens’ refugees who provide dialogue (interactive NPC), he/she can argue that they will survive without blankets. Now, he/she face the ethical problems associated to Proximity, which emotional and social closeness influence the decision to be taken. If he/she prioritizes the teens, elder refugees who cannot get the blankets will punish him/her with minus Social Reward. If the condition of elder refugees is critical, perhaps the refugees will lose their hit point. In this case, he/she will get Failure Reward. If he/she cannot satisfy the needs of teens’ refugees, on the other hand, the refugees will stop to annoy the response activities, but the response action will be delayed and it causes the response team members or commander giving minus point of Teammate Reward.

Now we continue to see the next job at the location of the injured woman. There is an injured woman trapped under a collapsed bridge. Her leg was broken, and she is unconscious. Weather center reports that the heavy rain is happening in the headwaters area. In the next few hours, the river waves will be raised and lead to subsequent flooding. The player has a responsibility to evacuate the injured woman before next flooding hit this area. The problem is that he/she does not carry enough equipment to cross the river with a swift current. He/she can request to the command center to deliver required equipment, but it takes time because the injured woman needs help immediately. These circumstances give him/her Deadline. If he/she cannot evacuate, he/she will lose the opportunity to save the injured woman’s life that perhaps break the woman family’s hope. If woman’s family felt let down, he/she will get minus point of Social Reward. On the other hand, because of its inability to evacuate on time, he/she loses the opportunity to save the woman. Hence he/she will get the Failure Reward.

5. Conclusion and Future Works

We have identified the RPG pattern of ethical gameplay. We found that the pattern of RPG applied to the example quest shows the game is potential to produce the meaningful of ethical gameplay. We are now working in progress of implementation of this pattern into complete playable game. However, there are still missing pattern for our research purposes. In the future, we expect to solve this weakness by studying other RPG patterns of established game. Another important work is to measure the effectiveness of the implemented pattern for training outcome through play testing of the playable game.

References


Aesthetic Design For Learning With Games

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Abstract: This paper presents a design framework for educational games utilizing the notion of game aesthetics. Aesthetics in games is presently defined by all the facets of gaming experienced by players either directly through audio and graphics or indirectly through rules, geography, temporal characteristics and number of players. Researchers have observed that learning depends on the aesthetic qualities of an instructional environment and therefore the design of effective learning environments is dependent on its aesthetic considerations. Using the aesthetic principles of instructional design and the Design/Creativity loop model as the overall framework this paper elucidates how a game can be aesthetically conceived to reveal the core learning concepts and complexities for a deeper engagement with the content. To emphasize the role of creativity, we conceptualize the design process through a comparative analysis between choreography and the aesthetic configuration of a game based learning environment. We present and discuss the parallel processes of these two creative and iterative design activities, using various exemplary educational games and West African dance forms.

Keywords: Aesthetics, game based learning environments, choreography, creativity in design

1. Introduction

Although game based learning environments are recognized as good media for learning and socialization through the dimension of play (Van Eck, 2006), designing games for classroom use to advance cognitive development has been a challenge. In order for teachers to use games in the classroom, they not only need to consider students’ level of engagement, motivation and prior knowledge but also ensure the alignment of the curriculum, pedagogical techniques and clear learning goals for games (Kirkland, Ulicsak & Harlington, 2010). Shute, Rieber and Van Eck, (2012) discussed that the hurdle faced with wider usage of games in classrooms is due to the lack of understanding of the gaming environments’ effects on learning and a corresponding lack of theory and practice for their design and implementation. Educational games can often be ineffective if they fail to unpack the students’ interests and extend them into the academic domain (Squire, 2011). We argue that learning becomes a meaningful experience when it is aesthetic in nature, and hence propose a reconceptualization of game design from an aesthetic perspective. An aesthetic learning experience is engaging, lends continuity to a learning process and is concerned with the qualitative meaning attributed to it (Parrish, 2009). Reemphasizing the importance of aesthetics in game design, Squire (2011) reiterates how design teams or designers must strive towards making game development an iterative or creative process with frequent prototyping and testing to create compelling educational experiences. We therefore advocate that game design as a process in itself has to be an aesthetic experience so that the designers engage in a creative process and are able to reflect their creativity through the aesthetics of game based learning environments.

2. Aesthetics and Creativity in Designing Game Based Learning Environments

An aesthetic experience is similar to being pulled out of one’s subjectivity into a web of relations that demand his or her attention (Gadamer, 2011). An aesthetic understanding depends on the notion of play through participation, which is crucial for individuals in deciphering the ways of the world (Jardine, 2006). Egenfeldt-Nielsen, Smith & Tosca (2013) from a purely technical point of view, define aesthetics in games constitute the elements such as audiovisuals, rules, geography, temporal features and number of players, and how these work in unison to showcase the experience of “how it plays” (p.
Learning environments possess aesthetic qualities, which become evident through instructional activities or methods that foster intellectual and emotional tensions or through content and strategies that provide significant learning experiences (Wilson, 2005; Parrish, 2009). Aesthetic experiences within learning environments make the learning immersive, meaningful, coherent, complete and transformative (Parrish, 2009). Extending the notion to game-based learning environments we suggest that aesthetics in games affects learning and plays a coherent role towards understanding the game (Gupta & Kim, 2014). In game-based learning the learners derive the meaning from interacting directly with the gaming world and through observations of the consequences of their actions (Squire, 2011). The aesthetics of a game also captures the subjective experience and invokes the emotional response of the players (Aleven, Myers, Easterday & Ogan, 2010). Game design, which brings out the aesthetic qualities, is therefore of immense importance for facilitating learning and creating meaningful learning experiences.

Aesthetic qualities help to establish the theme of learning if the issues arising from the subject are part of the situation (Parrish, 2009). Elements such as rules or geography can help present the problem and the theme of learning. Aesthetic qualities such as patterns, routines or motifs help to see the connections or the changes thus supplying an anchor for new learning (Parrish, 2009). Aesthetic elements of a game similarly provide patterns, routines or motifs, which holistically reveal the changes and connections as the game progresses. Aesthetic elements, especially visual representations, are critical for making sense of a game: they not only communicate educational concepts and enable players to see patterns in the gaming process but also shape and reshape various game elements depending on the player’s choices (Egenfeldt-Nielsen, Smith & Tosca, 2013; Squire, 2011). Aesthetic learning experiences also involve tension and anticipation in the course of clarifying a problem, making it challenging and engaging for learners (Parrish, 2009). We claim that aesthetic tension or anticipation arising out of the game elements can motivate the player impacting his or her critical thinking skills and emotions towards solving the problem (Gupta & Kim, 2014). We assert that creating a game-based learning environment rich in aesthetics demands embodying the above-mentioned aesthetic qualities in the design.

We also propose that the designers themselves have to undergo an aesthetical experience as instructional designers, to come up with creative designs for presenting a problem or a theme in a project. Hokanson and Miller (2009) suggested how designers have to be in a creative frame of mind for visualizing innovative ideas to commence and end the process of design. The Design/Creativity Loop Model (see Clinton & Hokanson, 2012) further develops the role of creativity by focusing on the various processes that take place during instructional design and development. The model illustrates an iterative process of creative thinking. The design process may commence with the problem identification or the creative vision and proceed to the preparation stage where the designer pursues supporting design tasks. Incubation involves creative endeavours of the designer while processing the design problems, which leads to illumination reflecting the designer’s comprehension of solutions. These solutions are derived through repeated mental iterations, which the designer then builds upon or verifies through the design.

Creativity in game design must surface through a mix of the visual arts, the content and the connections to learning theory (Squire, 2011). Drawing from Chen, Kasof, Himsel, Dmitrieva, Dong and Xue’s (2005) notion of creative response, we propose that an instructional design of a game, which involves insightful problem identification, divergent and evaluative thinking, is bound to extract creative responses from the learners. An instructional design process can bear similarities to an artistic approach “since designers can actually devise specific instructional strategies and make aesthetic decisions” (Clinton & Hokanson, 2012, p.123). Choreography is a highly artistic and creative process of design. It is an integral part of performance arts and we have chosen to explain the game design process by drawing similarities between the processes. We use the Design/Creativity Loop Model to understand the fundamental process of creative design and devise our own model specifically for an aesthetic design of game-based learning environments.

### 3. The Aesthetic Process of Designing a Game Based Learning Environment

Design requires creativity. Choreography often starts with an artistic intention, inspiration or vision and dwells on the possibility of finding novel solutions through a chain of reasoning (Pakes, 2009).
Choreography can emerge as an evidence of the synthesis of competing ideas such as problem finding, problem solving and metaphorical thinking (McKechnie & Stevens, 2009). The purpose of a choreographed dance therefore is to highlight an issue, express the process of resolving it and bring about a conclusive end to the narrative. The purpose of an educational game is similar: it identifies the issues in the context and engages players in the problem solving process within the game situation as the protagonist(s) in the narrative.

There are four creative operations of dance making – improvisation, development, evaluation and assimilation (Lavender, 2009). Improvisation begins with generating the artistic value of movements or dance structure ideas. Since it is exploratory, choreographers have to make critical choices about the form and structure of the movements based on their aesthetic values (Lavender & Predock-Linnell, 2001). The movements are then developed through the application of choreographic principles and devices. In order to infuse the movements with a particular energy or quality the choreographers may attend to the structural frames of the movements and alter the expressive details (Lavender, 2009). Choreographers then evaluate their actions and outcomes because choreography is a critical process that incorporates reflection, instantaneous or otherwise, to analyze, interpret and assess how the ideas are working towards shaping the dance (Lavender & Predock-Linnell, 2001). Finally choreographers assimilate all the materials they have composed to form smaller chunks that eventually coalesce into the fully formed dance, set for performance (Lavender, 2009). Thus choreographic approach remains entrenched in the aesthetic-artistic environment of the choreographers and goes through iterative stages of preparation, creative thinking and decision making regarding style, form, tempo or other characteristics. The final creative piece when woven together becomes an ensemble that has evolved as a dynamical system to communicate the flow of thought of the choreographer.

To understand how choreography bears similarities to the game design process we have devised a model (see Figure 1), drawing from key concepts of creativity in design (Clinton & Hokanson, 2012) and the creative operations of dance making.

Figure 1. The Aesthetic Game Design Cycle

The aesthetic game design cycle is based on the creativity of the individual designers and is not prescriptive but descriptive towards reorienting the process of game design. Creativity as an iterative process involves divergent thinking and is grounded in everyday capacities such as association of ideas, perception, analogical thinking or reflective self-criticism (Boden, 1998). As a creative endeavour the Aesthetic Game Design Cycle is therefore repetitive and cyclical. Using the aesthetic principles for instructional design (Parrish, 2009) we now elaborate how the aesthetic elements of a game establish the theme, create sustained engagement and anticipation and emerge through patterns and motifs that mark progression and novelty.

3.1 Establishing the Game Theme

Inspiration for choreography can stem from a piece of music, a visual concept, image or perhaps an emotion or feeling (McKechnie & Stevens, 2009; Pakes, 2009; Smith-Autard, 2009; D.J. Walsh, personal communication, 26th April, 2014). In comparison, the game designer has to identify the problem first, wrap it contextually (Clinton & Hokanson, 2012) to express the complexity so that there
are divergent means of solving the problem. The theme of learning as an aesthetic principle concerns itself with the learning activity (Parrish, 2009). Learning activity in game based environments evolves through game play where the focus has been to narratize the discipline or the subject through a core problem so that the learners can engage in socio-scientific inquiry (Barab, Sadler, Heiselt, Hickey & Zuicker, 2010). The narrative therefore becomes a framework for the aesthetic principles of instruction as it helps to understand the theme, the subject or the problem that is presented through the game. Narrative is an important element of choreography as it helps to conceptualize the dance (Lavender, 2009). The mini narratives or intention framing exercises both in design and choreography, thus help to build the narrative.

The aesthetic elements of a game can bring out the theme by portraying the conflicting information or the tension as the narrative progresses. Elements of a theme are decipherable from the rules of dance forms (Pakes, 2009). Rules define what the style will be (example Jazz, West African or Contemporary), and depending on the style chosen the rules help to elaborate the theme by establishing the structure, form, tempo, time signature and characteristics of the dance (Lavender, 2009). Genres or types of games are similarly classified by rules, which define the basic structure of the game. Depending on the theme the designer may choose completely open-ended environments (Assassin’s Creed) where the outcome of the game depends on the actions of the player or point and click games (On the Ground Reporter, Darfur) where the player’s actions are guided by artificial intelligence. In traditional West African dance, a wedding dance like Guinea Lamban, performed separately by men or women has a unique rhythm and certain signature movements. In Africa, dance serves as an index to the value systems that enable the community to interpret and express the various events of life (Nii-Yartey, 2009). Based on some of these rules, the choreographer can portray the narrative by sequencing the steps, modifying the artistic movements through complexities within the steps. (D.J.Walsh, personal communication, 26th April, 2014). Different genres of games (simulation exercises, role-playing games, building games etc) have different sets of rules. The designer is guided by these rules but can be creative within the defined parameters.

The choreographer or designer may choose to work on the geographical or spatial elements of the design for example (Lycouris, 2009; D.J.Walsh, personal communication, 26th April, 2014). The spatial arrangement can speak to the narrative and hence to the theme. The stage can be divided into halves or quadrants with site specific installations. Such arrangements play a crucial role in the choreographer’s decision. For example it can be a piece in isolation or an invitation to the audience to be part of the world (see Figure 3). A designer can similarly conceptualize the geography or the physical landscape to portray the theme accurately and help create the mood for the story to unfold (see Figure 2). Just like in a dance piece, the game designer has the option to select the number of players depending on the theme (see Figure 3), adding a social component to the game.

3.2 Creating Sustained Engagement and Anticipation

Once the choreographer/designer goes through a number of iterations of the creative cycle to arrive at major decisions (Decisive moments stage) regarding the theme, the process of elaboration and assimilation of the theme commences for the entire dance form/the game design. During this stage the
choreographer/designer can revisit the design to verify and elaborate towards sustaining the engagement and anticipation of the audience/players as well as their own visions.

Sustained engagement can be achieved in a learning environment through enhancement of the complication by introducing new tensions or complexities (Parrish, 2009). The game designer can reconstruct the narrative to introduce complications and create small achievements towards anticipation. Maintaining such anticipation demonstrates unity in the learning process and helps towards consummation of learning (Parrish, 2009). Small-scale tensions and consummations can come alive through the choreographic elements of intrigue, resolve or surprise (Nii-Yartey, 2009). Such elements are woven in through the changes of dynamic in audiovisual representations incorporating movement, music and lighting (McKechnie & Stevens, 2009). The form, style, tempo, time signatures, specific movements, spatial arrangements and number of dancers help to elaborate these minor complications within the choreography. In a similar way game designers can build up mini complications through the audio-visual representations or the narrative by suddenly exaggerating problems that appeared earlier or by augmenting unexpected turn of events through the game play.

The designer(s), having a thorough understanding of the problem may be further inspired to embed emergent problems within the parameters (curriculum) of the content/subject. Such emergent problems may be conceived through self-perception or through influences of the socio-cultural perspectives of the designers. These conflicts or problems can help establish continuity for the game.

3.3 Using Patterns, Routines and Motifs to Mark Progress

Patterns, routines and motifs are aesthetic traits that help to comprehend connections in the theme or even the narrative. Without patterns, routines or motifs the context emerges as chaotic and the novelty of situation is lost in the process (Parrish, 2009). Patterns in choreography cultivate a sense of understanding of the theme by reemphasizing certain dance movements (D.J.Walsh, personal communication, 26th April, 2014). In games patterns, routines and motifs are yardsticks for measuring progress particularly the onset of new situations, changes and connections in the problem. Patterns or routines repeated over time or through the action of players may have special significance towards comprehending the theme or narrative. The designer can elaborate on the theme by initiating the patterns and routines to establish the sequence or growth in the narrative. Repetitive patterns in West African rhythms emphasize the organic flow of one movement to the other (Nii-Yartey, 2009) which introduces novelties and meaningful progression. Patterns can also be established in games using the rules, geography, characters, the tempo as well as through the music and visual artistry. In On the Ground Reporter Darfur, as the player travels to a new area, a certain piece of music is repeated to establish familiarity and progress.

3. Implication and Conclusion

Games, which have strong elements of aesthetics and are conceived through a creative process, enable the learners to come up with creative responses to the theme, content or problems. As the learners start making sense of the aesthetic elements they create their own framework, which define and shape their understanding. The aesthetic qualities of the gaming environment thus specify, depict and convey visual representations to the learners. Characters, contexts, events or even objects within game based learning environments may serve as emotional anchors of learning depending on their aesthetic capacity (Kim & Kim, 2010). Each interaction in the game evokes different emotions from learners depending upon their sociocultural context. They seek solutions, which serve as artifacts or evidence of learning and the learners develop new identities to establish their learning. As noted earlier game based learning is often not used in classrooms for lack of proper pedagogies. However when the game designers establish themselves as model protagonists and experienced learners by revealing their own creative perceptions and sociocultural understandings through their game design, educators and researchers can better understand how games facilitate meaningful learning experiences and contribute to knowledge advancement. By sharing what motivated them to design the game they share their expertise in the subject or field through their creative design. Creativity is an integral part of instructional design, and aesthetic designs for learning environments and games need to be important aspect of the design process.
References


Enhancing Motivation in Disaster Prevention Learning with Perceptual and Semantic Gaming

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Abstract: Hazard maps provide knowledge about evacuation behavior, in addition to graphical indications of areas influenced by a disaster. However, without prerequisite knowledge or map reading literacy, it is not easy for citizens to fully understand hazard maps. Learning support systems for disaster education must thus be effective in lightening the learning load and enhancing motivation for learning. If the content is not held in memory, learners would need to repeat the learning session, which would lessen their motivation for learning. Moreover, natural disasters do not happen often, and cannot always be predicted. Therefore, it is not easy to enhance citizens’ motivation for disaster prevention learning. This can result in a vicious circle between degraded motivation and insufficient prerequisite knowledge. In this paper, we propose a learning support framework that helps gain learners’ attention by gaming at two different processing levels and facilitates retention of disaster prevention knowledge on the basis of priming effect on implicit memory. The key idea behind this framework is to utilize two components: implicit learning by means of implicit memory and memory retention based on levels-of-processing effect, so that the vicious circle between degraded motivation and insufficient prerequisite knowledge can be disrupted.

Keywords: Disaster education, learning strategy, gaming, enhancing motivation

1. Introduction

In addition to graphical indication of areas affected by a disaster, hazard maps provide knowledge about evacuation behavior which enable decision making by concerned individuals. It is crucial for area residents to understand the significance and use of hazard maps distributed by local governments so that their self assistance ability can be improved. Without prerequisite knowledge or map reading literacy, however, it is not easy for many citizens to fully understand hazard maps. Therefore, the development of a learning support system which not only facilitates retention of the preliminary knowledge for hazard map comprehension but also enhances motivation for disaster prevention learning is essential.

Learning support systems for disaster education must be effective in lightening the learning load and enhancing motivation for learning. However, readiness for disaster prevention cannot be sustained unless previously learned content is firmly held in learners’ memory, and the learners are motivated to repeat the learning process. If learned contents are not kept in memory, the learners have to review the learning sessions, which would reduce their intrinsic motivation for further learning. Moreover, as natural disasters do not happen often and cannot always be accurately predicted in advance, it is not easy to enhance residents’ motivation for disaster prevention learning. This can result in a vicious circle between degraded motivation and insufficient prerequisite knowledge.

According to the ARCS model of motivation design (Keller, 1987), instructional environments need to be designed, so that learners’ attention can be grabbed by stimulating their curiosity under unpredictable circumstances, and a sense of achievement can be formed by giving satisfaction. In this paper, we propose a learning support framework that attracts learner’s attention by gaming and facilitates retention of disaster prevention knowledge by means of priming effect on implicit memory (Reber, 1989). This paper also reports the results of an empirical evaluation with a prototype system.
2. Learning Support Framework

2.1 Cognitive Psychological Findings Applied for the Learning Support Framework

Memory without explicit consciousness of recall (implicit memory) is distinct from memory with consciousness of recall (explicit memory). A learning process that produces an effect on implicit memory is called implicit learning (Reber, 1989), and the effect brought about by implicit memory is known as priming effect. The priming effect is a kind of learning effect because memory tasks without conscious recall result in a positive effect on subsequent memory tasks (Terasawa, 1998). The positive effect can last for an extended period of time; for example, Komatsu (1984) demonstrated the priming effect was observed 5 weeks later when presented with a short stimulus of 3.5 second duration.

In human information processing, the depth of mental processing ranges from shallow to deep (e.g., structural, phonemic, and semantic). Deeper levels of processing achieve higher memory retention, which is called the levels-of-processing effect (Craik & Lockhart, 1972). Since more processing resources are required to accommodate the increase in process level or mental load, deeper level processing takes longer to complete (Craik & Tulving, 1975). The load at the semantic level is thus higher than that at the perceptual level. On the other hand, the cognitive load is quite small for shallow processes. However, repeating shallow processes can not lead to an improvement in memory retention even if the entire learning load is small throughout the course of the repetition (Craik & Lockhart, 1972). Memory retention based on the levels-of-processing effect and implicit learning have been adopted individually for previous learning strategies. In this study, we propose a learning support framework that utilizes these two components to break the above-mentioned vicious circle between degraded motivation and insufficient prerequisite knowledge.

2.2 Approach to Motivational Enhancement

Here we use the term “gaming” in the sense of simulation (Duke, 1974), which involves a representation or a model of reality in software. Players take the central role while in use, and that motivates players to learn readily from a particular scenario. In the area of disaster prevention learning, a card game called “Cross Road” (Yamori, 2012) was devised to attract learners’ interest and improve disaster imagination by challenging players’ judgment under time-varying uncertain situations. Most learning support systems make the learners aware of learning content in the original context of the simulation, and the learning contents are stored in the learner’s explicit memory. In our learning support framework, on the other hand, learning content is associated with constituents in a gaming context that is easier for learners to comprehend than in the context of the target field that is unfamiliar due to their lack of preliminary knowledge.

In our framework the learning process starts with gaming for implicit learning, where learning content is exposed merely as objects in the gaming scene without regard to the meaning of the context.
of disaster prevention knowledge; in the next stage, those objects are presented for explicit learning where all content is presented explicitly in the sense of a particular target field (Figure 1). According to this distinction of the presentation context, this framework facilitates retention of knowledge by associating preliminary knowledge or graphic symbols recognized during the perceptual task (e.g., bridge, underpass, and evacuation shelter in Figure 2(a)) with an entity in a target field appearing in the subsequent semantic task (e.g., underpass in Figure 2(b)).

3. A Prototype System for Flood Disaster Prevention Learning

Figure 3 shows a learning process based on our framework mentioned above, which includes a perceptual game for implicit learning and a semantic gaming for explicit learning. Each game is followed by a session for giving background knowledge. In the remainder of this section, the perceptual and semantic games are further explained.

3.1 Perceptual Game for Implicit Learning

In the prototype system, a shooting game targeting graphical symbols of map legends (Figure 2(a)) was used as a game for implicit learning with a perceptual task (hereinafter referred to as a perceptual game). In the perceptual game, five graphical symbols given in Table 1 (evacuation shelter, welfare evacuation shelter, gauging station, underpass, and bridge) were used as shooting targets. These targets are square, and their side length is one fourth of the screen height. These targets appear randomly from the left side and move linearly toward the right, and the moving time of a target from one side to another is about 2 seconds. With a maximum 12 targets appear on the screen at one time, and totally 32 targets appear during a gaming session in the prototype system.

The perceptual game, which consists of two sessions, is presented first to the learners (Figure 3(1)). The first session of the perceptual game exposes moving map legend symbols, and requests learners to touch as many of the symbols as possible. The number of touched symbols are counted and recorded as game’s score. In the second session, additional rules are explained to the learners, namely, when symbols which stand for dangerous places (e.g., bridge and underpass) are touched, the number of such touched symbols is subtracted from the total score, while the number is added when symbols for safe places such as an evacuation shelter are touched. These additional constraints for gaming intend to encourage implicit understanding of the distinction between dangerous and safe places in the map legend. Note that the learning here is conducted implicitly because at this moment game users do not know that the map legend symbols are part of disaster evacuation knowledge. Since the perceptual game is a very simple shooting game, it allows the learner to concentrate more on touching graphical symbols. The key point here is that implicit learning during the perceptual game facilitates explicit learning by producing a priming effect later in the semantic gaming.
The learning effect of the proposed framework was tested in two web-based experiments with a total of 144 participants. In the first experiment (Hirai, Tanaka and Hori, 2013a), the rate of correct answers for the test of related knowledge differed significantly among presence (97.2) and absence (85.4) of prime conditions, $p < .05$, and the correct answer rate was higher in presence of prime condition. In the second experiment (Hirai, Tanaka and Hori, 2013b) depicted in Figure 4, the rates of correct answers for the tests of legend and related knowledge differed with marginal significance under presence or absence of prime conditions, $.05 < p < .10$. These results indicate that the rate of correct answers was higher in presence of prime conditions in both cases. The results of these experimental studies demonstrated the effect of memory retention of map legends and their related knowledge when perceptual-level information was presented before exposure to semantic information.

3.2 Semantic Game for Explicit Learning

As gaming for explicit learning in the semantic task phase (hereinafter referred to as semantic game), simulation games that mimics disaster situations were used. The semantic games required that the
activity in the game correspond to the rules of the real disaster situation. The current prototype system provides with six semantic games featuring each of the six map legends in Table 1. When played with these semantic games, learners cannot make a higher score unless they understand the meaning of the map legends and their implications in disaster situation.

### 3.3 Gaming Simulation for Setting off Unsafe Behavior

It is not difficult for learners, for the most cases, to understand appropriate evacuation behavior as knowledge of disaster prevention. For example, it is straightforward to know why flooded underpasses should not be went through by cars. It is just because cars would be submerged and got stuck on the way. However, people sometimes fails to apply such knowledge to take an appropriate action, due to the so-called knowledge-to-action gap. Even if a learning support system simply presents a dangerous situation to learners, it does not necessarily mean the learners take unsafe actions spontaneously. For a better understanding of unsafe behavior in disaster prevention learning, simulation is useful since learners’ behavior can be contextualized in a dangerous situation. Thus it is a crucial requirement for a learning support system to lead learners to take unsafe actions spontaneously.

In our learning support system, semantic games allow learners to take unsafe actions under the simulated or explicit context of semantic tasks. For example, a semantic game for underpass is realized as a role-playing game (Figure 2(b)). In essence, a semantic game can be regarded as a multiple choice test because the players finally select one of the actions available in the gaming contexts. In the field of cognitive psychology, a phenomenon called the testing effect is known, which means that taking a memory test repeatedly produces substantially better retention than studying learning materials (Roediger & Karpicke, 2006). Taking account of the effect of this finding, semantic gaming is expected to contribute to enhancing memory retention because gaming facilitate for the learners to take tests or semantic games repeatedly.

<table>
<thead>
<tr>
<th>Map legend and symbol used in the perceptual game</th>
<th>Task descriptions of each semantic game</th>
</tr>
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<tbody>
<tr>
<td>Flood water depth</td>
<td>Choose a building in which to shelter outside an area being flooded, before the time nearby rivers are flooded.</td>
</tr>
<tr>
<td>Gauging station</td>
<td>Quickly choose a correct action based on emergency information presented at random.</td>
</tr>
<tr>
<td>Evacuation shelter</td>
<td>Manipulate a graphic symbol of an evacuee and, by way of save road, navigate it to an evacuation shelter within the set time.</td>
</tr>
<tr>
<td>Welfare evacuation shelter</td>
<td>Connect explanatory text to the illustration that most appropriately describes the scene of assisting vulnerable people.</td>
</tr>
<tr>
<td>Underpass</td>
<td>Operate a graphic symbol of a car, and choose a command of battle action to fight with an anthropomorphic, flooded underpass (Figure 2(b)).</td>
</tr>
<tr>
<td>Bridge</td>
<td>Operate a character of a little bonze, and choose a direction of movement to buy dumplings on a rainy day.</td>
</tr>
</tbody>
</table>
4. Concluding Remarks

We set up a resident experience booth during an evacuation drill held in an area of Takatsuki City in Osaka Prefecture, Japan, on Nov. 9, 2013. About 100 local residents from children to the elderly participated in this drill. We provided a tablet terminal to participants at the venue so they could experience the prototype system. We then conducted an interview survey and a questionnaire survey. The proposed system gave local residents the opportunity to think about their behavior in disaster by directing their attention to the importance of flood hazard maps. It was confirmed from the experience that the disaster prevention information presented by the prototype system was understandable, and that residents were very interested in playing the prototype games. At the closing session of the disaster prevention drill, our activities were appreciated by the head of Takatsuki City Crisis Management Office as substantially contributing to increasing the awareness of disaster prevention for local residents. We are going to put this research to practical use and continue to develop application systems for disaster prevention education to be tested in schools and communities.

References


Game-based APP in Teaching Newton's Three Laws of Motion for High Schools Students

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\textsuperscript{*}hyshyu@mail.tku.edu.tw

Abstract: This study aims to design and develop an interactive game-based learning APP for teaching Newton's three laws of motion for High Schools Students and examine students’ attitudes towards Secondary Physics and this game-based learning materials. Subjects were 278 students in junior and senior high school. Results indicated that there was a significant difference between pretest and posttest and gender on attitudes toward learning physics (p< .05). In addition, the results from interviews with 6 high school teachers showed they were positive toward this software and its effects. Some suggestions for revisions were made from the students and teachers for further improvement.

Keywords: game-based learning, APP, physics education, mobile learning, Newton's three laws of motion

1. Introduction

Horizon Report (2012) has forecasted the most promising technologies likely to impact on K-12 education, such as: mobile devices & Apps, tablet computing, game-based learning, personal learning environments, augmented reality, natural user interfaces. Prensky (2001) pointed that the digital game based learning (DGBL) can solve the boring problem in the traditional classroom learning. He further claimed that students grow up along with the technology belonging to “game generation”. Education for the game generation is different from that for previous generation. For example, digital games have been reported using in schools in many fields (Guillén-Nieto & Aleson-Carbonell, 2012; Kennedy-Clark, 2011; Oblinger, 2004; Staiano& Calvert, 2011; Young et al., 2012). Numerous studies also noted that the digital learning will increase students’ motivation in learning and enhance their learning performance (Adachi & Willoughby, 2013; Kirriemuir & McFarlane, 2004; Hjert-Bernardi & Anderson, 2011). However, does gamed-based educational app still work in a physics course for a specific topic? This is the key question that we want to get the answer in this study. In this paper, we try to develop a game-based app for students according to the scenario-oriented strategies to learn Newton’s Laws of motion. In the beginning, we raised the learning issues of physics courses. Then, we addressed our educational app design for learning the Newton’s laws of motion which followed the digital game-based learning (DGBL). Finally, we tested and explained the effects on attitudes toward learning physics with the app.

1.1 State of problem. New technologies have a powerful influence on all aspects of our daily life. Many of them have an impact on the way we teach and learn. There are inconsiderable tendencies, including the reform of teaching models, the trend of information evolution, the convenience of making good use of mobile devices, grasping the advantages of applying technology in learning, and the teaching strategies of combination of challenging hands-on practice and contributing to autonomous learning. At the present time teaching physics in junior and senior high schools is quite challenging. The main problem is that students lack intention of learning in a traditional class; however, they are proficient with computers and interested in new things. It will be helpful to elevate students’ intention if the learning environment is built with the technology of virtual reality for students (Parkinson & Hudson, 2002; Shyu & Chou, 2012). Moreover, the basics of physics are complicated and they need more mathematic logic computation. It takes a great amount of time for teachers to explain a phenomena in science; therefore, students find it strenuous to learn physics. There is deficiency of time,
which troubles teachers while teaching. Students are not able to understand the aim and application of the basics, thus the experimental course will be needed to explain the basics of theories and the utilization of the application. If virtual reality technology is applied to construct 3D related game-based learning, it will be of benefit to students with low learning motivation.

Huang (2009) has pointed out that many physics students in college are familiar with the laws of physics; however, students’ practical application of all kinds of basic physics often surprisingly disappoints professors. That may be due to junior and senior high school students’ motivation for learning physics is merely for passing the entrance examination. By doing so, it diminishes students’ interest in physics and cognition of utilization of physics. In addition, the work effectiveness of applications of simulation software needs verifying. All current simulation software has come into existence for a while and most of them adopted techniques such as Java and Flash. As a consequence, the screen is limited to a 2D range, and fails to display in 3D. There are limitations to show the applications of physics. Moreover, trends of mobile learning and education cloud contribute to mobilization, cross platforms and facilitation of teaching materials.

1.2 Purposes of Study

The purpose of this study attempts to carry out an instructional design based on Newton’s Three Laws of Motion. A cross-platform game-based material APP using 3D virtual reality technology is designed and produced. It is hoped that students can learn physics in a game-based virtual environment on cross-platform with a mobile device so that learning can be vivid and interesting, which elevates junior and senior high students’ motivation for learning physics. Thus, it is hoped that the junior and senior high students receive an experimental instruction so as to acquire the understanding of how the product contributes to their physics learning and what attitude they have towards the physics game-based material. The aims of this paper are threefold: 1. to develop appropriate physics game-based APP - The Newton Rabbit: Newton’s Three Laws of Motion; 2. to examine the feasibility of the product, e. g., to examine the change of students’ attitude towards learning physics and the teachers’ acceptability of the product and suggestions; 3. to explore the differences of the students of different genders after the students learning physics through physics games.

2. Game Design

2.1 Game Scenario

Newton Rabbit is a scenario-based educational APP for learning Newton's three laws of motion. It starts with a story of a crowd of rabbits living on the moon. They have to apply Newton's laws in order to defeat the soldiers on earth, accomplish the tasks and then back home. In the end of the game, the result was shown to either fail or success, including the number of rabbits succeeded to return to the Moon. The software is intended to motivate high school students' interests and problem-solving abilities in learning science.

2.1 Game Features

Newton’s Rabbit, was mainly developed from the game-based learning design principles based on literature review. The game itself has an easy and intriguing plot with three stages. Students can increase their pleasant experience of learning through games. The complexity of learning physics, in traditional classroom, often makes students lose their motivation for learning it; therefore, the playability and challenges were taken into consideration while the game was designed. For example, (Shown in Stage One) players will face a challenge that they have to know how to launch the rabbit to the moon accurately. Accordingly, players explore and acquire the understanding of the theory of F=MA and of application of the theory as well. After players get engaged in the game and gain a sense of achievement so as to enhance their motivation. In a traditional learning process, a teacher usually lectures along with numerous exercises. In the long run, students merely know how to calculate instead of acquiring knowledge. This app (Newton’s Rabbit) emphasizes the discovery and exploration of the relationship between variables through interaction. Therefore, conflicts and choices were designed. For example, the Newton Rabbit in Stage Two, players need to choose to move the rabbit to face the bullets attacking and use the law of reaction to eliminate the bullets from the enemy. In this case, the back and forth design can help students understand and attempt to explain the importance of the reaction force in this stage. Players have the rabbits block the bullets and remove the enemy through the feedback loops. In addition, students are assisted in setting a goal to make the rabbit come back to the earth from the moon in the last stage (Stage Three) so as to gain rewards. This work embedded the knowledge
concepts in the game. Not only can students understand Newton’s Three Laws of Motion by completing game stages, but the learning process can be elaborated in a competitive atmosphere in order to gain a satisfying evaluation and reach an educational goal via entertainment. This app (Newton’s Rabbit) is a cross-platform game whose system supports computers, smartphones and tablets. We summary the features of this material as following:

1. The screen layout is so vivid that it can attract students’ attention.
2. The characters-goofy looking rabbits are so cute that players cannot help but fall for them.
3. The way of playing a series of stage games makes students think and apply the knowledge of physics
4. The instructions, most of which can be carried out with a finger (on a mobile device) or with a mouse (on a computer), are easy and clear. Hence, students can get the hang of it rapidly.
5. The design with multi-versions enables students to play it at home or download it to a mobile device to enjoy it anytime anywhere.

Figure 1. Starting the Game

Figure 2. Stage one- Newton's Second Law of Motion

Figure 3. Stage two-Newton's Third Law of Motion

Figure 4: Stage two Newton's Third Law of Motion

Figure 5. Instructions for Stage Two

Figure 6. Instructions for State One

3. Research Design

The design-based research was applied to develop Newton Rabbit using ADDIE model. The App was developed by Unity 3D, 3DMaxTM, and PoserTM. Then, the questionnaires were administered before
and after the instruction. The participants in this experiment were 278 students from 8 high schools in Taiwan.

4. Results

4.1 Attitudes toward Learning Physics. Subjects were administered both before and after the treatment with the questionnaires of a pretest and posttest on attitudes towards learning physics. The pretest was 3.11, and the posttest was 3.93, indicating most of students had a positive attitudes toward physics. The results of a corelated t-test revealed that students’s attitudes toward learning physics significantly improved after learning with Newton Rabbit (p<.05).

<table>
<thead>
<tr>
<th>Table 2: Pretest and Posttest on Attitudes toward Learning Physics</th>
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<tbody>
<tr>
<td>Attitudes toward learning Physics</td>
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<tr>
<td>----------------------------------</td>
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<tr>
<td>Newtonts Rabbit help me less afraid of learning physics</td>
</tr>
<tr>
<td>I enjoy the way of learning physics with Newton’s Rabbit</td>
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<tr>
<td>Over all, Newton’s Rabbit helps me learn physics in a better way.</td>
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<tr>
<td>Average</td>
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A further investigation was found that most students liked Newton Rabbits because it was interesting, can enhance motivation, and enjoy the way of this learning. Students also expressed Newton Rabbit can help them learn physics and would like to try more Apps like Newton Rabbit.

<table>
<thead>
<tr>
<th>Table 3: Posttest on Attitudes</th>
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<tbody>
<tr>
<td>Items</td>
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<td>-------</td>
</tr>
<tr>
<td>Newton’s Rabbit make learning physics more interesting</td>
</tr>
<tr>
<td>Newton’s Rabbit enhance my learning motivation</td>
</tr>
<tr>
<td>Newton’s Rabbit help me less afraid of learning physics</td>
</tr>
<tr>
<td>I am willing to spend more time on learning physics with Newton’s Rabbit</td>
</tr>
<tr>
<td>Newton’s Rabbit help me understand the principle of Newton’s laws.</td>
</tr>
<tr>
<td>I enjoy the way of learning physics with Newton’s Rabbit</td>
</tr>
<tr>
<td>I would like to try more activities of Apps in learning physics like Newton’s Rabbit</td>
</tr>
<tr>
<td>Over all, Newton’s Rabbit helps me learn physics in a better way.</td>
</tr>
<tr>
<td>Average</td>
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4.2 Gender Differences in Attitudes toward Learning Physics with APP. The results of a t-test between gender indicated there was a significant difference (p<.05). The girls felt more positive toward learning physics with APP than the boys.

<table>
<thead>
<tr>
<th>Table: Gender difference on Attitudes</th>
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<tbody>
<tr>
<td>gender</td>
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</tr>
<tr>
<td>Male</td>
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<tr>
<td>Female</td>
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**P< .001

5 Conclusions and Suggestions

This study attempted to awaken teachers’ attentions to the effects of a game-based APP in assisting middle school students to learn physics-Newton’s Three Laws of Motion. The results, which were based on empirical evidences and interviews with teachers and students, have been shown very positive. It is explained that the scenario-and- game-based APP has helped students learn physics and promote physics education in middle schools. Moreover, boys are usually more familiar with game-based software than girls, and they have an advantage of the (positive) learning attitude over girls. This study
indicated that this kind of game-base APP for learning physics is popular with girls, and girls’ positive attitude is better than boys’. As a consequence, the results of the study have suggested that the future of game-based software is promising. Meanwhile, Taiwan’s government has been promoting the educational apps market to K-12 schools. The results of the present study yielded from the experience of research and students’ feedbacks on the APP can offer an example of the development of design and application to educational technology industry, including game-based learning software, application of school education, and textbook publishers, and instructional material designers. It is hoped that the game-based learning APP can be applied on a large scale.

References


Gamification in Academia Practice – What Motivate Users Most

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Abstract: Gamification is the use of game design elements and game mechanisms in non-game context to increase audience’s motivation and engagement. Not only being applied on the commercial market to attract consumers, gamification is also used in educational context by teachers to help keeping students engaged and motivated in the physical classrooms. This paper furthermore upraises the discussion of how the gamification strategies can be implemented online for a website with academic purposes to retain its members, and what of which are the members’ most concerns a designer should adapt to if time and resource are limited. Examples are given and an online survey of 73 subjects with empirical experience was conduct to reveal that among those game mechanisms proposed, the graphical feedbacks are the subjects’ most concerns, followed by the gamified theme activity and discussion board. For websites which are not gameplay purposed this paper could provide useful suggestions for the designers who try to use gamification for enhancing the audience’s participation and enthusiasm, even for educational purposes.

Keywords: Gamification, Game mechanisms, Game elements, Motivation, Engagement

1. Introduction

Gamification, an emerged trend of using game mechanisms or elements in non-game context for increasing audience’s motivation and engagement, needs more designers’ efforts to arrange and carefully implement for integrating with the non-game target than just design a pure game. It is more likely that game designers try from the beginning to pack a non-game target by using game design strategies for the insipid and unattractive content or context concerned by the audience. The concept is based on that the game elements in entertaining video games should be able to make other, non-game applications more enjoyable and engaging as well (Flatla, Gutwin, Nacke, Bateman, & Mandryk, 2011). However, the definition of game elements and how to use it for gamification brings up debates among researchers and will be discussed in the later literature review section.

Non-game content or context covers many domains including commercial market and education, therefore the purpose of applying gamification could be at least divided into two different perspectives: organization benefit and meaningfulness for students or the target audience. Nicholson (2012) argues that the long-term benefits to the company eventually result from the positive and meaningful benefits for the user, therefore a user-centered theoretical framework was proposed, in theory and in ideal condition. However, for short lifetime products or for promotion in the competitive market, a gamification designer is inevitably bound with limited time, budget and the needs of the organization, therefore our study tries to identify what mechanisms are most concerned or welcomed by the target audience to save the designers.

Another setting of this study is putting the gamification online. Take gamification in education for example, in most real cases gamification is implemented in just the physical classroom for teaching. In which context a teacher can easily arrange or modify the gamification strategy in a controllable environment for gathered students, however to digitize the gamification strategy or mechanisms online is a different thing, and usually ignored in many gamification 101 guidelines for education (Fioriello, 2013; Lepi, 2013). The survey samples of this study were then collected online from those who have the experience of visiting membership websites with gamification applied digitally. The membership sites may be an educational platform with personnel account setting, or a commercial site with lucky draw...
games, or a forum with different discussion boards. One thing in common among those sites is their goals of retaining and increasing the members’ engagements and motivations for visiting. We hope that through this survey and discussion, valuable efficiency gamification design data could be provided for future related research.

2. Literature reviews

Gamification uses game-thinking and playful design in non-game context as a motivational tool to engage people (de-Marcos, Domínguez, Saenz-de-Navarrete, & Pagés, 2014). Ryan and Deci (2000) distinguished motivation into two types, the intrinsic and extrinsic motivation in their early Self-Determination Theory (SDT). Based on the reasons or goals that give rise to an action, the intrinsic motivation refers to people doing something because it is inherently interesting or enjoyable, while the extrinsic motivation refer to doing something because it leads to a separable outcome, e.g., rewards, punishments or pressures. In the classic literature extrinsic motivation has typically been characterized as a low quality form that contrasts with intrinsic motivation, yet in Ryan and Deci’s taxonomy the extrinsic motivation still plays an important role and has the great opportunity to internalize and integrate with the external regulation therefore results in an orientation shift, Deci furthermore discussed the effects of all rewards and did explicit analyzing to clear that the understanding of intrinsic motivation by tangible rewards is indeed a significance issue (Deci, Koestner, & Ryan, 2001).

Wang and Sun (2011) further linked the usage of reward system as the extrinsic motivation for video game experience. They discussed how game reward systems can be used to motivate or change behaviors in the physical world, as well as how reward mechanisms foster intrinsic motivation while giving extrinsic rewards. Eight virtual reward forms in digital game worlds were proposed including score system, point system like experience point, item granting system, virtual resources like wood and stone for building facilities in certain games, achievement system, feedback messages as instant reward, plot animation and pictures like cutscenes and badges, and unlocking mechanism for accessing new game content. These reward forms give clues for our later gamification design on how to provide positive player experiences, establish status, attract attention, and help players building social connections with others.

For the nature of gameplays the inherent fun, interesting and enjoyment of games can be typically linked to the intrinsic motivation and considered as a high quality form, therefore many discussions of game-based learning, game-based training, or serious games which use an off-the-shelf game as a medium or as a game-based motivational tool to engage the target audience are emerging in recent years. However if there is no existing game for increasing people’s motivation of doing something that is inherently without fun and enjoyment, the alternative approach which uses the advantage of game’s motivation linkage to repack the insipid task with a game form, in other words, to gamify a non-game activity for increasing people’s engagement, is gamification promisingly.

Since a non-game context is different from games from the bottom, it is hard to just find and extract a fine game’s subtle core spirit to replace the non-game’s heart. That is why most gamification theorists turn to discuss the game design elements, game mechanisms and strategies to try building the guidelines for gamifying the targets. Brathwaite and Schreiber (2009) use the term game design atoms to introduce the elements of games, including the game states, a collection of all relevant virtual information that may change during play; players, avatars and game bits - the art assets such as icons, sprites, objects, NPCs or monsters; the game mechanics which are rules acting upon the above to change the game state and are the ingredients of game design, not to mention the game dynamics, goals and theme.

Reeves and Read (2009) argues that some so called game elements like avatars, ranks, levels, time pressure, competition rules and some other ingredients can also be found outside of games or are not necessarily in different game genres, therefore would not be readily identified as ‘gameful’, let alone game specific. In addition, how game elements are perceived can be a very subjective judgment depending on different perspectives of designers or players.

Since what game elements are is still need to be discussed, Deterding, Dixon, Khaled, and Nacke (2011) restrict gamification to the description of elements that are characteristic to games, and reserve the term for the use of gamifying design. Although the definition may bring up another debate
for what is “characteristic” of games, their proposed levels of game design elements give the practitioner a direction to design gamification, show as table 1 below.

Table 1: Levels of Game Design Elements (Deterding et al., 2011)

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game interface Design patterns</td>
<td>Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations</td>
<td>Badge, leaderboard, level</td>
</tr>
<tr>
<td>Game design patterns and mechanics</td>
<td>Commonly reoccurring parts of the design of a game that concern gameplay</td>
<td>Time constraint, limited resources, turns</td>
</tr>
<tr>
<td>Game design principles and heuristics</td>
<td>Evaluative guidelines to approach a design problem or analyze a given design solution</td>
<td>Enduring play, clear goals, variety of game styles</td>
</tr>
<tr>
<td>Game models</td>
<td>Conceptual models of the components of games or game experience</td>
<td>MDA; challenge, fantasy, curiosity; game design atoms; CEGE</td>
</tr>
<tr>
<td>Game design methods</td>
<td>Game design-specific practices and processes</td>
<td>Playtesting, playcentric design, value conscious game design</td>
</tr>
</tbody>
</table>

As can be seen in table 1, game interface design patterns with implemented solutions such as badge and leaderboard, are distinguished from game design patterns or game mechanics which can be implemented with many different interface elements, therefore are more abstract and treated as distinct.

Besides those models and theories proposed in the academic research, from commercial market a gamification agency Bunchball.com publishes its white paper to link human desires as game dynamics with game mechanics, such as points, levels, challenges, leaderboards, gifting and charity. Table 2 from Bunchball.com gives a clear picture of how each game mechanic interacts with human desires, respectively. The black dots signify the primary desire a particular game mechanic fulfills, and the white dots show the other areas that it affects.

Table 2: The interaction of basic human desires and game play, adapted from Bunchball.com (2010)

<table>
<thead>
<tr>
<th>Human Desires</th>
<th>Reward</th>
<th>Status</th>
<th>Achievement</th>
<th>Self Expression</th>
<th>Competition</th>
<th>Altruism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game Mechanics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Levels</td>
<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Challenges</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Virtual Goods</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Leaderboards</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Gifting and Charity</td>
<td>○</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
</tbody>
</table>

The implemented solutions above for gamification are now often seen in many websites with membership registration to record each member’s performance or engagement by accumulated points, level, leaderboard and other game interface design mechanisms such as badges and trophies (de-Marcos et al., 2014; Domínguez et al., 2013). Although using virtual pictorial reward is considered as task-contingent, performance-contingent or completion-contingent rewards which is categorized into extrinsic rewards (Deci et al., 2001) and will decrease intrinsic motivation, many commercial operations still use extrinsic rewards including tangible, material ones, e.g., money and prizes, to attract potential customers. From instructional aspect the decreasing of intrinsic motivation may result in students’ low learning performance, however in commercial marketing perspectives, it is worthy to use
extrinsic rewards like lottery or draw lots to promote the sales of a short-lifetime product, therefore we regularly argue that a full understanding of the gamification purposes in different context with additional factors and considerations is necessary.

To sum up, games are typically considered to provide joyful intrinsic motivation, and gamification tries to parse that characteristic of games for applying on the non-game applications. Because people may lack intrinsic motivation for non-game applications, extrinsic motivation such as rewards or other regulations may be necessary for the gamifying process to engage people. In the above reviews many game design mechanisms are discussed, yet from the gamification experienced users’ perspective, which mechanism brings up the most motivation or is not essential, is still need to be explored for efficient gamification design.

3. Methods and implementation

An online survey was used to investigate the expectations of subjects regarding the usage of the game interface design elements in their favorite membership websites. To assure that all subjects at least have experienced one membership website with gamification mechanisms, the survey is deployed on our multi-purposes platform, LOPUPA (http://lopupa.npust.edu.tw), “learning on projects of united promotion for academia.” The ultimate goal of the platform design is to gamify the process of academic activities in the National Pingtung University of Science and Technology, NPUST. Faculties can use the platform to introduce or promote their projects or research outcomes, students can demonstrate their projects for feedbacks, other members can interact with the non-game educational context and become research samples, industries can contact the faculties, students and members for cooperation opportunities or marketing purposes.

Game design mechanisms are implemented in the platform including points, leaderboards, challenges and rewards, etc. Table 3 describes the design of point mechanism in LOPUPA, three types of point are introduced, and the tangible rewards system is shown in fig. 1.

Table 3: The point mechanism in LOPUPA

<table>
<thead>
<tr>
<th>Point type</th>
<th>Obtain methods</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience Point</td>
<td>Personnel engagement with LOPUPA: Logins, participating online single player activities, responding online surveys.</td>
<td>Quantitate the interactions between user and the system</td>
</tr>
<tr>
<td>Charisma Point</td>
<td>Social engagement in LOPUPA: Using discussion boards, participating online multi-user activities to interact with other users.</td>
<td>Quantitate the interactions among users.</td>
</tr>
<tr>
<td>Gift Point</td>
<td>converted by activity rules: X*(EP) + Y*(CP) – GP spent for gifts = GP X, Y depends on each activity design.</td>
<td>Virtual currency to convert user performance for exchanging real incentive gifts as tangible rewards.</td>
</tr>
</tbody>
</table>

![Figure 1. The reward system for gift point exchange](https://example.com/reward-system.png)
The thematic activities and web games are also provided to introduce and engage people in NPUST content made by its faculties and students, fig. 2 shows the portal. As described in Table 2, these challenging arrangements may fulfill the human desires for competition, achievement and more, including self-expression as one of the LOPUPA members shows his/her complete collection of collectable cards in the Hakka activity discussion board as in fig. 3.

Figure 2. The thematic activity and thematic web game module

Figure 3. The LOPUPA member who first completed collecting all collectable cards in an activity posted his/her achievement in the discussion board

With the deployment and implementation above, our survey subjects are registered members who are exposed to the gamification platform and aware of the mechanisms, therefore their answers and suggestions could reflect the authentic responses for improving gamification strategies in the future.

4. Results and Conclusion

A Likert-type seven-point scale with options ranged from 1 (very disagreeable) to 7 (very agreeable) is deployed, and 73 members responded. The result of the questionnaire showed the top three mean values fall into: Graphical incentives is a must have to make my determination more strong for completing the online theme activity or web games (\(M = 5.59, SD = 1.41\)); Online theme activity or thematic web games of a membership website can keep my interest and retain my visits (\(M = 5.55, SD = 1.41\)); and Discussion board is a must have to open my communication with other members or web administrators to keep my enthusiasm (\(M = 5.55, SD = 1.41\)).

The survey reveals that graphical virtual feedbacks such as trophies, badges or collectable cards, the theme activities or web games and the discussion board are the top three welcomed
gamification methods. These finding could be explained as follows accordingly: members like to have their online self-fulfillment displayed in graphics, members’ retention are mainly because they have interests in the theme activities regarding the website property, and members like to have community interactions by social tools which has been proofed in de-Marco’s gamification and social networking study. On the contrast, the leaderboard has the lowest score comparatively, suggesting that displaying accomplishments for competition with others is not so important from the members’ perspectives.

Although the tangible rewards are not attractive enough to make it on the top of the list in our study, in the open question section of the survey, some members do respond with the expectations of gift varieties, lower point thresholds for gift exchanging, and having a lottery instead of accumulating gift points by continuously participating the theme activities or web games. However we must consider the balance between the members’ wishes and the organization’s gamification purposes and resource, making the strategy of proper balancing issue our future considerations, including the frequency of developing new theme activities or thematic web games.

This article reports the empirical investigation of gamification for educational promotion context. Unlike small classroom surveys in other similar gamification researches, a gamified platform LOPUPA was established with faculties, students, visitors and industries involved, and an online survey was conducted to understand which mechanisms are the most important for members’ retention and engagement through the internet. Our future work will include the further analysis of how users interact with the strategy from the play theory’s point of view, and the implementation of Google Analytics to retrieve the global view of user behaviors. The digital gamification services or web designers therefore could be benefited by our research outcomes.

References

Enhancing Children’s Numeracy & Te Reo Skills using Computer Games

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Abstract: The use of computer games as common vehicles for education, as opposed to pure entertainment, has gained immense popularity in recent years. In our earlier work, we investigated the appealing characteristics of engaging computer games for children and designed an educational tool based on those characteristics. In this paper, we present the results of a study conducted with 120 primary school children, in which two versions of our proposed educational tool (features enriched vs feature devoid) were used for four weeks to teach primary school curriculum areas of Numeracy and Te Reo Maori language. The effectiveness of the educational tool was measured using a pre-test and a post-test, as well as other indicators such as subjective analysis, the frequency and duration of time on playing the game. We found that the features enriched game enhanced children’s learning in both Numeracy and Te Reo curriculum areas more than the feature devoid version. In the case of Numeracy, the increase in scores was twice as much as the feature devoid version and in the case of Te Reo it was five times as much. Finally, the results of the subjective analysis showed that the feature enriched game was more popular with children – the test group indicated that they enjoyed playing the game more than the participants in the control group and are more likely to recommend it to their friends. The results also showed that the sound effects, the visual effects, the level of challenges in the game and the feedback messages contributed more to their engagement.

Keywords: Learning, games, literacy, numeracy, engagement, children

1. Introduction

The success rate of computer games in engaging children has prompted educational researchers to investigate if similar techniques can be used to engage children with learning. Studies carried out by Fisch (2005) and Chen et al (2011) are two out of the many such studies which have focused on how to achieve positive results for learning by playing games. A key factor which has generated a lot of interest is the capacity of such games to engage the players for extended periods of time. There are certain attributes of computer games which contribute to how well they are received by the players. Designers of educational tools can integrate these attributes to maximise the tool’s effectiveness in increasing learning outcomes, level of engagement and motivation. According to Prensky (2001), a prerequisite of successful learning is motivation. He argues that a lot of what is in the curriculum is not motivating for students these days. Yet the same children are motivated and excited to play video games for long duration. What is notable is that some children’s attitude towards video games is the opposite of the attitude they have towards learning in schools. One way of getting children motivated is to design educational tools with the aim of making them as engaging and motivating as popular commercial games. These tools can be integrated with the curriculum to enhance children’s learning.

In our earlier work, we investigated the main characteristics of engaging computer games (i.e. graphics, feedback and challenge) and designed an educational tool with those characteristics embedded into it (Nand et al, 2013). This paper seeks to examine the effectiveness of our proposed educational tool in enhancing students’ knowledge of Numeracy and Maori Language – two subjects heavily used in New Zealand primary school curriculum.

The remainder of this paper is organised as follows. Section 2 reports on the current literature. Section 3 briefly describes our proposed educational tool. We then present the research questions, evaluation study and the results in Section 4, followed by conclusions and future work.
2. Related Work

The use of technology, such as computer games, to enhance student achievement in the classroom is a timely topic that permeates a lot of educational literature today. Video and computer game design have been studied by various researchers interested in finding out how different aspects of the game design could be utilised in developing educational games (e.g. Malone, 1981; Dondlinger, 2007; Pinelle et al 2008). The increase in the popularity of games and recent developments in information and computer technologies have attracted researchers to investigate the learning benefits of computer games.

There have been a number of studies showing that children’s learning increased as a result of playing computer games. Research (e.g., Csikszentmihalyi, 1990; Rogoff, 1990) has shown that game playing makes up a vital element of a child’s cognitive and social development. These studies assert that children learn more from playing and carrying out “hands-on” activities than by being simply asked to “recite” information from books. According to Vygotsky (1976), children learn by playing with others, creating and improving their zone of proximal developments. Fisch (2005) has noted that children have learnt about diverse subjects such as prehistory and asthma education by playing computer games. The learning aspect of computer games has been further endorsed by Chen et al (2011). In this study, the researchers proposed a set of design guidelines that can be ideally applied to any game to teach children how to manage their diabetes. The preliminary results of their research showed that users enjoyed playing the game and they believed their knowledge of diabetes increased as a result of playing the game. Other examples of educational and health-related games include Consolvo et al., 2006; Fujiki et al., 2008; Alankus et al., 2010.

Based on our experience, most of the educational games available in New Zealand primary schools are not motivating enough for students. These games lack the fun factor. Children are not as motivated to play these games as they are to play popular computer and video games at home. Most of the games that do exist are usually the basic grill and drill practice models. There is a need to develop useful and instructional computer games, which are relevant to the current New Zealand curriculum and can be integrated in the day to day learning. In our previous study, we investigated the main characteristics of computer games used to engage player for a long period of time. We then designed an educational tool based on the feedback we collected.

3. Game Design

We selected a group of 120 children aged between 9-10 at Glen Eden Primary School in Auckland, NZ. They were given a questionnaire and were asked to choose 3 features (from a given list) of computer games that they found most appealing. The following game attributes were most appealing (Nand et al., 2013):

- **Challenges (CH):** having different levels in the game
- **Feedback (FB):** knowing how many points were scored
- **Graphics (GH):** having realistic graphics

The participants were also asked to select the curriculum area in which they preferred a game to be designed in. The Topics Related part included Science, Social Studies, Technology and Te Reo (Mario language). A vast number of children were interested in playing numeracy games. Some of the reasons given as to why they wanted a numeracy game developed included: “I want to get better at maths”, “I want to learn my multiplication facts”, “Learning maths in a game will be a fun way to learn” and “I don’t like maths so playing a game and learning will be better”.

Driven by the three main characteristics identified by the target group and described in the previous section (i.e CH, FB and GH), a variety of open source games were examined. We felt that the Java-based open source game “Who wants to be an Millionaire”(http://quizshow.sourceforge.net/download.html) is a suitable option to choose for the preliminary evaluation (see Fig. 1). It was also identified as one of the games children enjoyed playing; hence modifications were made to incorporate educational features into it.
The game is based on a television game show in which the participants are offered cash prizes for correctly answering a series of multiple-choice questions in the order of increasing difficulty levels. This game can be configured easily to include any content. New content can be added by including the questions at various levels as a text file. Choosing an incorrect answer at any point in the game ends the current session, with a feedback message saying the game can be played again from the beginning. Depending on when the incorrect answer is given, the player can leave with either no money or certain amount. The amount a player can leave with depends on the level reached. The game designed for this study had three levels indicated by an amount written in white font compared to the rest of the amounts which are written in yellow font (see Fig. 1). Once a player passes a level indicated by the amounts $1,000, $32,000 and $1 million, the player can leave anytime with the money associated with the highest previous level reached. This applies in both cases: when a player voluntarily chooses to leave the game and/or when the player gets an incorrect answer.

The two subject areas chosen for this study were Numeracy and Te Reo (Maori language). Numeracy was chosen because a large number of students had identified numeracy in the questionnaire as one of the areas they wanted to play games in. The New Zealand Numeracy Curriculum was used in order to determine the level of question suitable for the children selected for the study. In order for the game to be enjoyable and engaging, it was necessary that the players were given the type of questions of which they had prior knowledge and which were not extremely difficult or “boringly” easy (e.g. a good solution was to provide a progressive level of skills). Their teachers were consulted and the numeracy levels of the children were taken into consideration. Te Reo (Maori Language) was chosen to be the second subject to teach, since this was an area of learning in which there were very limited educational games. Te Reo is a component of the NZ Primary School curriculum. The teachers of the selected group of students were again consulted to find out what competency level the students were in Te Reo. The questions designed for the Te Reo game were then compiled in line with the children’s competence. The questions were based around identifying everyday items, recalling numbers, naming the colour range, as well as naming the days of the week. The children in the study group were expected to have prior knowledge on these topics. We developed two versions. The first version was a Feature Enriched Game (FEG) which had extensive use of the three identified features (i.e. CH, FB & GH) and the second version, a Feature Devoid Game (FDG) had overt absence of these features. To learn more about the proposed features and how they were integrated into FEG version of the game, refer to our earlier work (Nand et al, 2013).

4. Evaluation Study

Our research questions in this study are as follows: 1) How will the domain of the game (Literacy vs
Numeracy) affect users’ learning outcome? 2) Do children enjoy using the proposed educational tool with the embedded characteristics?

The Evaluation study was conducted with 120 children aged 9-10 at Glen Eden Primary School in Auckland. The participants were divided into a Control group and a Test group of 60 students each. Both groups were pre-tested firstly on the numeracy learning outcomes. The Test group was given the FEG version to play over a period of two weeks and the Control group was given the FDG version to play over two weeks. Both groups were given post tests on the numeracy learning outcome. Both groups were then pre-tested on the Te Reo learning outcome. The test group was given the Te Reo FEG version to play over a period of two weeks and the Control group was given the Te Reo FDG version to play over two weeks. Both groups were given post tests on the Te Reo learning outcome.

Both FEG and FDG versions of the game were installed on the 12 available computers in the school library and as time permitted, pupils in groups of 12 were given the games to play in a separate room with the computers. Both Control and Test groups played at different times and were not able to see what version of game each group was playing. There was a deliberate attempt to keep the two group’s playing times separate. The students were allowed to play the game for about 20 minutes without any interference from the researcher or any of the other teachers. At the end of a maximum of 30 minutes the students were stopped and allowed to go back to their classrooms.

4.1 Measuring Children’s Learning

Measuring children’s learning was our main dependent variable. In order to do that, we used a pre-test, post-test and interaction logs. The pre-test was conducted to measure student knowledge before using the educational tool and the post-test was used to measure the learning outcome after using the educational tool. The questions in the tests were similar to the ones used by teachers in assessing their students in numeracy and their knowledge of Maori language. The pre-test and the post-test for each of the curriculum areas were done using the same questions. This gave us a direct measurement of the change in the learning outcome. The results are reported in Table 1.

Table 1a: Statistics for the Pre and Post Scores for the Numeracy experiment

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Control Group Pre Test</th>
<th>Control Group Post Test</th>
<th>Test Group Pre Test</th>
<th>Test Group Post Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Average</td>
<td>12.12</td>
<td>12.97</td>
<td>12.87</td>
<td>14.77</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>4.30</td>
<td>4.21</td>
<td>4.55</td>
<td>3.51</td>
</tr>
<tr>
<td>Relative Std. Dev. (%)</td>
<td>35.5</td>
<td>32.5</td>
<td>35.4</td>
<td>23.8</td>
</tr>
</tbody>
</table>

Table 1b: Statistics for the Pre and Post Scores for the Te Reo experiment

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Control Group Pre Test</th>
<th>Control Group Post Test</th>
<th>Test Group Pre Test</th>
<th>Test Group Post Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Average</td>
<td>8.35</td>
<td>8.85</td>
<td>10.52</td>
<td>14.18</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>3.47</td>
<td>3.41</td>
<td>3.22</td>
<td>3.42</td>
</tr>
<tr>
<td>Relative Std. Dev. (%)</td>
<td>41.6</td>
<td>38.6</td>
<td>30.7</td>
<td>24.1</td>
</tr>
</tbody>
</table>

As we can see, the average scores for both domains have increased after playing both versions of the game. For numeracy domain (Table 1a), the average for the control group has increased from 12.12 to 12.97 and for the test group, has gone up from 12.87 to 14.77. In addition, the absolute score for these equate to an increase of 0.85 or 7% for the control group and an increase of 1.9 or 14.8% for the test group. Thus, the percentage increase in the mean score is twice as much for the FEG compared to the FDG game. Comparison of the post-test scores for the control and the test groups (12.97 compared to 14.77) also shows that the FEG was more effective in raising the performance level of the students. The T-Test values are $3.63 \times 10^{-10}$ for the Control group and $1.31 \times 10^{-13}$ for the Test group. Both values are orders of magnitude smaller than 0.05, showing that the change in the learning outcome (post-test vs pre-test) was statistically significant for both groups. Additionally, the T-Test value for the Test group is orders of magnitude smaller than the Control group, implying a significant effect of the FEG. The
corresponding figures for the Te Reo game is 0.5 or 6% increase for the control group compared to 3.66 or 34.8% for the test group. This gives us an approximately 6 fold increase in the learning score for the Te Reo experiment. The results in the case of the Te Reo curriculum also show a similar pattern to the Numeracy curriculum, in that the test group performed better compared with the control group.

In addition, the participants in the Test group (for both Numeracy and Te Reo domains) attempted more questions in average, provided more correct answers, spent more time playing the game and reached more levels compared with the Control group – this indicates that the FEG version was better utilised compared with the FDG.

### 4.2 Analysis of Post-Game Questionnaire Responses

After playing the FEG and the FDG versions of the game over a period of four weeks, the students were given a questionnaire to fill out in order to collect information about their perception of the game. Figure 2 shows the participants’ responses to whether they would recommend the game to their friends. As it can be seen, the students in the Test group were more likely to recommend the game to their friends (38 definitely and 17 possibly). On the other hand, very few students in the Control group were likely to do so (1 definitely and 9 possibly). A little more than half of the students in the Control group (17 not at all and 24 not really) said they would not recommend the game, as opposed to only 1 student in the Test group.

Our results also show that the Test group enjoyed playing the game more than the Control group and was more inclined to want to play the game again. We believe that the presence of the key three features, i.e., the sound & visuals effects, level of challenges in the game and the feedback messages contributed more to their engagement. The FDG version, used by the Control group, was devoid of those features, which resulted in them not wanting to play the game again nor wanting to recommend it to their friends. Moreover, visual observations of students while playing the game showed that the Test group was more engaged and excited with the sound and the graphics compared to the control group. Their expressions and body language demonstrated that they were motivated to keep on playing and they finally had to be stopped at the end of the session. Some of the participants, for example, were shouting in delight when they were given feedback about their answers, smiled and talked to their friend sitting next to them often and shared how they were progressing in the game. On the other hand, the Control group playing the FDG version looked less interested and engaged, and some of them asked if they could leave the session earlier. The game did not seem to hold their attention as they were seen to be fidgeting and their attention seemed to drift from the game to observe what others in the room were doing.
5. Conclusions & Future Work

In this paper, we examined the effectiveness of our educational tool in enhancing students’ knowledge of Numeracy and Maori Language, as well as conducting a subjective analysis amongst the participants. The tool is designed based on the characteristics of engaging computer games identified in our previous study, i.e. graphics (GH), feedback (FB) and challenge (CH). We conducted the evaluation study with 120 primary school children aged 9-10, at Glen Eden Primary School in Auckland. The main dependent variable used was the amount of learning that took place, measured with the use of pre-test and post-test and user interaction data.

The results showed that the proposed features embedded into the learning tool were effective in significantly improving learning outcomes. The results of the subject analysis indicated that the Test group enjoyed playing with the game more than the participants in the control group and that the sound effects, the visual effects, the level of challenges and the feedback messages contributed more to their engagement. The test group is also more likely to want to play the game again. We also found that the test group did significantly better when working on the Te Reo questions than Numeracy. The much greater increase in the learning outcome score for Te Reo indicates that the educational tool was especially effective for this curricular. This can be attributed to the difference in the types of learning involved in the two curricula. Te Reo involves fact-based learning where the student is required to learn and recall facts. On the other hand, the Numeracy learning task is based on problem solving; it involves more fact manipulation operations and various intermediate steps in order to arrive at the final answer. The intermediate steps were not fully supported in the current version of the tool designed for this study. In spite of this, the FEG version significantly improved learning outcomes for Numeracy, which can be even further improved by adapting the game for more fact manipulation or cognitive based curricula.

An immediate future work identified from this study is to adapt the game for more cognitive based learning tasks. In addition, a more comprehensive set of questions with intermediate questions can be developed in the game to guide the user to a final answer. It would be interesting to see if the effectiveness of the feature enriched educational tool would also be valid in other scenarios such as for secondary school children and in other curriculum areas. We also plan to conduct a long-term study to find out if there will be significant increase in learning outcomes and amount of enjoyment as opposed to a two week study. We believe our research paves the way for the systematic design and development of full-fledged engaging educational tools.

References
Learning English Words via Visual Media using Tablet PCs

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Abstract: A tablet PC system using an etymological memorization method with animations can enable Japanese children to memorize English words. The system specifically helps with memorization of compound nouns, which are combination of two simple nouns, for animals. For each noun it shows an animation with a narration produced by a voice synthesizer, followed by an animation showing the compound noun, again with narration. The system was experimentally evaluated by comparing the effectiveness of using animation, pictures, and text.

Keywords: Learning English Words, Etymological memorization method, Tablet PCs.

1. Introduction

We have developed a system of iPad applications that is effective in enabling children to memorize English words yet enjoy themselves while learning English. The system specifically helps with memorization of compound nouns, which are combination of two simple nouns.

A compound noun is a combination of two or more simple nouns such that the meaning can be derived from the meanings of the simple nouns. We think that this concept is important for training English learners at an early age, because children come to understand the meanings of various words by considering etymology. For example, Japanese students have difficulty predicting the meaning of a new English word, because Japanese and English are so different. In particular, it is difficult to cope with a complex English word at first sight. The meaning can be made predictable, however, by dividing the word and thinking about the etymology of each part. Using this approach, students can learn many English words that they do not already know. In Japan, full-scale English education starts from junior high school. We want to encourage children to maintain this applied word learning skill for future English learning, and that is why we developed this system of iPad applications before entering junior high school.

Therefore, in our system we apply an etymological memorization method (Zhang and Han 2004), which entails learning compound words by being conscious of the origin of each constituent word. For example, “centipede” consists of “centi” (hundred) and “pede” (foot). The idea is that the learning effect should be increased by learning words via animations for understanding both compound nouns and their constituent simple nouns.

Our group has extensively researched content understanding through animation and shown that animations are effective for understanding content and vocabulary (Sumi and Tanaka 2005), (Sumi and Nagata 2011), (Sumi and Nagata 2012). In general, animations have been shown to improve understanding and recall of text, making them an effective tool for promoting learning (Levie and Lentz 1982). Research has also shown that animations increase motivation to learn (Rieber 1991). This paper introduces our system and presents a comparative evaluation with elementary school students as subjects using the system with animations, pictures, and Japanese characters.

In addition, we think that after a student learns compound nouns, improvement in long-term memory is possible through the opportunity to use those nouns several times. For example, consider the case of building a simple sentence by combining a noun and a verb. Therefore, our system also has a function for sentence construction, in which the student combines memorized compound nouns and verbs and views corresponding animations.

As for the effect of the etymological memorization method, research has verified its learning effect and indicated the advantage of being able to imagine the meaning of an unknown word by being conscious of etymology (Kikuchi 2011). Another study (Suzuki 2011) examined etymology learning by showing
English words corresponding to Japanese words. This study involved changing the colors of the constituents of a compound noun and showing the whole noun, with a beneficial learning effect for some subjects. We thus adopt the technique in our system of separating English words by color according to etymology.

The field of second language acquisition attaches importance to conveying a message through the meaning of the language rather than focusing on the form of the language. The etymological memorization method corresponds to such basic learning for conveying a message, since learners understand the meaning of the language. This system is also related to the classic flash card systems of computer-assisted language learning (CALL).

This paper investigates the additional effects of animations, pictures, and characters. The sentence construction application entices children to generate an animation by choosing a noun and verb intuitively. It aims to imprint English words on students’ memories via learning in an enjoyable way.

2. English Vocabulary Learning Applications

The system consists of four applications: “English Vocabulary,” “Sentence Construction,” “Vocabulary Quiz,” and “Word Meaning Deduction Quiz.” The “English Vocabulary” application operates in three different ways, using animations, pictures, or Japanese characters, to compare the effects of these three approaches. The picture and Japanese character approaches respectively show a freeze frame of a picture or Japanese characters representing a noun. In contrast, the animation approach expresses an explanatory state in which, for each noun, an animated animal appears and coalesces from a smoke screen, so that the application finally shows the animal corresponding to a compound noun.

We chose animal nouns as the target words because they are familiar to children. The field of second language acquisition considers background knowledge important for understanding input (Krashen 1985). To make learning more effective by exploiting the learner’s field of interest (Shirai 2004), we thus chose animal words.

After learning compound animal nouns, students can use the Sentence Construction application to build sentences using the compound nouns while seeing animations of the corresponding animals. Students then use the Vocabulary Quiz application to confirm how many words they have memorized. We also developed the Word Meaning Detection Quiz application to see if children could deduce the meanings of unlearned compound nouns merely from hints in the form of simple nouns. The system keeps track of the current time, the class, the student number, the application, and the student’s numbers of correct and incorrect answers.

All applications were developed using Adobe Flash Professional CS6, Adobe AIR for iOS, and ActionScript 3.0. All icons and pictures were created using Adobe Illustrator CS5. Sound for words in English was obtained from Google’s speech synthesis system with words recorded beforehand in MP3 format. The system was designed to clearly express English words through pictures and animations and to support intuitive operation leveraging the benefits of the iPad.

2.1 English Vocabulary application

As noted above, the English Vocabulary application operates in one of three ways, using animations, pictures, or Japanese characters. We chose compound nouns for ten kinds of animals. In a preparatory experiment, we confirmed that ten English compound nouns in our system were not familiar to Japanese fifth and sixth graders, although they knew the Japanese words for these animals. We concluded that memorization of ten words was a sufficient challenge for these students.

The starting screen displays icons for these ten compound nouns. Touching one of the ten icons switches the screen to the corresponding learning screen for the compound noun. Touching the “?” button causes the animation (or picture, or Japanese character) corresponding to the word to be shown on the screen, with the sound of the word in English played at the same time. Similarly, touching the “=” button causes the application to show the animation (picture, character) and play the sound corresponding to the whole compound noun. Furthermore, the animation shows the process of joining the two English words forming the compound together. The sound can be replayed by touching the icon.
2.2 Sentence Construction Application

The Sentence Construction application is designed to promote long-term word memorization through sentence construction. The student chooses a compound noun, which has already been learned, and a simple verb. The starting screen displays icons for the ten compound nouns and ten suitable verbs. The compound nouns, listed on the left side, and the verbs, listed on the right side, can be selected by dragging each into the respective left or right part of the center area. The animation for the resulting sentence then appears in the lower part of the screen.

2.3 Vocabulary Quiz Application

The Vocabulary Quiz application is used to confirm whether the student was able to memorize the compound nouns. The application provides two kinds of quizzes, called Test 1 and Test 2. In both tests, upon seeing the corresponding characters and hearing the corresponding sound, the student chooses an answer by selecting one of four icons to represent the compound noun. In Test 1, the four answer choices consist of two of the compound nouns, including the correct answer, and two simple nouns. In Test 2, the four choices consist of three compound nouns and one simple noun. For the word test in our experiment we adopted Test 2, which is more difficult than Test 1, according to the results of a pre-test experiment with children.

The spoken compound noun can be replayed by touching the button next to the word. If the student selects the right answer, the application switches to a “correct answer” screen with a corresponding sound. Likewise, if the student selects a wrong answer, the application switches to an “incorrect answer” screen with a corresponding sound. One of six different screens is finally shown according to the number of correct answers.

Note here that our system keeps track of the current time, the class, the student number, the application, and the student’s numbers of correct and incorrect answers.

2.4 Word Meaning Deduction Quiz Application

This application is used to confirm whether the student can deduce the meaning of an unlearned compound noun from the etymology of English words. As in the Vocabulary Quiz application, this etymology quiz lets the student choose an answer by selecting one of four icons expressing a compound noun, upon seeing the corresponding character and hearing the corresponding sound. Because this test has a high difficulty level, the system shows hints in the form of pictures and characters for words with helpful etymology.

3. Experiment

We held an English learning workshop using our system with 111 children: 34 sixth graders (20 boys, 14 girls), and 77 fifth graders (38 boys, 39 girls). We analyzed the following issues: (1) comparison among media, in terms of which media are effective for memorizing nouns; (2) whether sentence construction is effective for memorizing English words; (3) whether the system differs in effectiveness depending on experience in learning English; (4) whether the system differs in effectiveness depending on cognitive style; (5) and whether, after learning nouns, students find sentence construction by combining a noun with a simple verb effective for memorization.

We used the Vocabulary Quiz application as a word test, and the Word Meaning Deduction Quiz application as an etymology test.

To compare effectiveness, we also developed English vocabulary applications using pictures and Japanese characters, in addition to the application using animations.

We pretested and distributed the subjects into five groups, without differentiation according to gender, English learning experience, or cognitive style. A chi-square test showed no significant difference in bias in the number of subjects for any cross tabulations. The allotment to each group was thus non-biased.

Group 1 used the English Vocabulary application with animations and the Sentence Construction application. Group 2 used the English Vocabulary application with pictures and the Sentence
Construction application. Groups 3, 4, and 5 used only the English Vocabulary application, with animations, pictures, and Japanese characters, respectively. We used the Group Embedded Figures Test (GEFT) to screen cognitive styles. The GEFT involves looking for a specified figure from among various provided figures. It consists of seven practice questions as the first section (two minutes), and 18 real questions as the second and third sections (five minutes each). We measured how many figures children could identify before running out of time. Then, we classified children with zero to nine correct answers as having a field-dependent cognitive style, and those with 10 to 18 correct answers as having a field-independent cognitive style. We translated the GEFT into Japanese because the original GEFT is in English.

Note here that the cognitive style (either field-dependent or field-independent) refers to how people classify personal characteristics, according to differences in the methods used to receive, constitute, analyze, and remember information and experiences (Hojo 1991). People with a field-dependent cognitive style receive the structure of an image as shown, without revising it, and they interact with it. They fuse all elements in the field of vision, without dividing what they see into visual components. On the other hand, people with a field-independent cognitive style consider an image to be a visual stimulus. They can either decompose the image when it is organized or add an original structure when it is not organized. As a result, these people can precisely distinguish specific information in a complicated picture (Moore and Dwyer 1991). For junior high students with a field-independent cognitive style, Hojo (Hojo 1991) found a strong learning effect when they used pictures in English learning. He concluded that because the analysis and estimation abilities of field-independent learners are superior for coping with this problem, they can use information from a picture more effectively.

Before this main experiment, we conducted a preparatory experiment using our system with 18 children at a different elementary school. The subjects used the English Vocabulary application with animations (or pictures). Through this experiment we (1) determined the number of repeated times using the system required to learn an English word, and we confirmed (2) the adequacy of the difficulty of the words and quiz and (3) the system’s user-friendliness. We found that there was a difference in the number of times required when the students used the system freely within a limited time. Therefore, we revised the system to maintain a consistent number of times for learning, and we also decided to develop an application using Japanese characters, because there was little difference in results between the animation and picture cases.

As comparison among media, analysis of variance showed no significant difference in scores after using the three different media (F(2,43) = 0.17, p < .05).

As effectiveness of sentence construction, analysis of variance showed no significant difference in word test scores between Groups 1 and 2 (t = -0.75, df = 63, n.s.). On the other hand, there was a significant difference in etymology test scores between these groups (t = -2.56, df = 63, p < 0.05). This suggests that deducing new English words was easier using the application with pictures than using the application with animations.

As effectiveness depending on differences in English learning experience, there was a significant difference in scores between Groups 1(experienced) and 2(experienced) (t = -2.35, df = 63, p < 0.05). That is, among the subjects with English learning experience, the application using pictures was more effective than that using animations, before sentence construction. There was also a significant difference in scores between Groups 2(non-experienced) and 2(experienced) (t = -2.96, df = 32, p < 0.05). This means that in the case of learning using the application with pictures, the subjects with English learning experienced performed better than did the non-experienced subjects.

The average etymology test scores were also categorized by English learning experience. There was a significant difference in scores between Groups 1(experienced) and 2(experienced) (t = -2.22, df = 63, p > 0.05). That is, among the subjects with English learning experience, the application using pictures was more effective than that using animations. There was also a significant difference in scores between Groups 1-1 and 2-1 (t = -1.81, df = 17, p > 0.05). This means that among the non-experienced subjects, as well, the application using pictures was more effective than that using animations for deducing new English words. Lastly, there was a significant difference in scores between Groups 2(experienced) and 4(experienced) (t = 2.28, df = 47, p > 0.05). In other words, among the subjects with English learning experience, the application using pictures was more effective than that using animations for deducing new English words.
4. Discussion

Our analysis showed that the English Vocabulary application using pictures, rather than animations or Japanese characters, was the most effective for memorization. In particular, the system was effective for subjects with experience learning English. Moreover, the application using pictures was more effective for children with a field-independent cognitive style than for those with a field-dependent style. Another interesting result was that, for recalling memorized English words one week later, learning with both the English Vocabulary application (using pictures or animations) and the Sentence Construction application was better than learning only with the vocabulary application (using pictures or animations). This demonstrates the effectiveness of sentence construction for learning English vocabulary, thus confirming our hypothesis that building sentences with the Sentence Construction application after learning English words should have a learning effect, specifically for long-term learning.

After the experiment we administered questionnaires to the subjects, offering the chance for free response, and we gleaned the following opinions. For the question, “Were the positions and colors of screen icons easy to recognize?”, there were many favorable comments. Examples include “The application was very colorful and characters were easy to recognize,” “The icons for ‘? + ? =’ were easy to comprehend,” and “It was easy because of the sounds played with the words.”

For the question, “Was learning English fun?” there were also many favorable comments. In this case responses include “It was very fun, unlike learning from a textbook,” “I have come to like English so far, though it was hard,” “It was fun because of the Sentence Construction application,” “I thought it was very good that I could learn English while playing a game, and it was fun,” “I could learn English like a game and it was fun,” “The Sentence Construction application was very fun,” and “It was good to learn even with a quiz.”

For the question, “Was learning English easy?”, as well, there were many favorable comments. Examples for this question include “It was easy, because the system spoke the words,” and “It was easy, because the words were made up of other words.” Other comments include “Though it was difficult, it was fun,” and “It was sometimes difficult and sometimes easy.”

Finally, for the question, “Was it easy to learn English with this method?”, there were also many favorable comments. In this case responses include “Because I understood the pronunciation by hearing it and the English was written, it was easy to learn,” “Because I could hear the sound, it was easy,” “I could learn English with this system rather than by having someone explain it,” “It was easy to understand, because of the audio pronunciation,” “It attracted everyone’s interest that we could use an iPad system with sound,” and “It was easy to learn more than usual, because we always learn English only by hearing.”

The field of image psychology postulates that learning effects are determined by such factors as “variables in the image,” “characteristic differences in the actor,” and “the kind of problem.” Here, “variables in the image” refers to media, such as animation. The phrase “characteristic differences in the actor” means the subject’s ability. Finally, “the kind of problem” means the problem to be solved, such as learning English words. In this case, we investigated the problem of learning English words by using animations, pictures, and Japanese characters, for children who either do or do not have English learning experience and have either a field-dependent or field-independent cognitive style.

Our hypothesis was that the learning effect would be enhanced by using animations for learning English words, and we thus expected that animations would have a higher effect on learning than would pictures or characters. The learning effectiveness of showing a picture or animation with text was demonstrated in studies by (Cowen 1984) and (Peeck 1974). Additionally, because animation can express the process of combining two English words to create a compound noun, we thought that animation should produce better results than with pictures or characters. For example, the system can present an explanatory animation of an animal noun appearing and coalescing beyond a smoke screen. We found, however, that such explanatory presentations through animation had little or no value and no relation to memorizing English words. It might be that unnecessary movement disrupts memory, or there might be a more suitable speed for presenting images to promote memorization. According to (Levie and Lentz 1982), visual representations have both a cognitive function that facilitates learning from text by improving understanding and retention, and an attentional function that attracts attention to the content. Visual representations could obstruct learning, however, when they capture the learner’s attention, because visual representations themselves contain mixed information (Levie and Lentz 1982). Thus, we
conclude that our experimental result for the animation condition was caused by the explanatory animations attracting the learner’s attention and obstructing learning. As a result, the child subjects could gain interest in English learning and learn in an enjoyable way via our iPad-based system. By using the system’s applications to repeat the cycle of learning through memorizing, building sentences, watching animations, and taking a quiz, the elementary school children became more familiar with English, more aware of etymology, and more prepared for further English learning in junior high school.

5. Conclusion

In this paper, we have introduced an iPad-based system to help Japanese students learn English compound nouns while having fun. The system consists of four applications: “English Vocabulary,” “Sentence Construction,” “Vocabulary Quiz,” and “Word Meaning Deduction Quiz.” We conducted an experiment with our system and analyzed the results in terms of various subjects and conditions. As a result, the English Vocabulary application using pictures, rather than animations or Japanese characters, was the most effective for memorization. In particular, the system was effective for subjects with experience learning English. Moreover, the application using pictures was more effective for children with a field-independent cognitive style than for those with a field-dependent style. For recalling memorized English words one week later, learning with both the English Vocabulary application (using pictures or animations) and the Sentence Construction application was better than learning only with the vocabulary application (using pictures or animations).

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References

On the Design of Embodiment-based Gamification Activities for Learning Fundamental Projectile Motion

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Abstract: Based on theories of embodied cognition, this study applied technologies of natural user interface to design gamification activities for learning fundamental projectile motion. The embodiment-based design facilitates elementary learners to learn the abstract concept of fundamental projectile motion through their body-moving experience. When the learners perform gamification activities with their body movements, they can construct their knowledge schema through external perceptions. This study recruited 60 fourth to sixth grade students to participate the experiment. The participants were randomly and equally divided into body-moving learning group and finger-touching learning group. The learners in the body-moving learning group directly use their body movements to accomplish the gamification learning activities. On the other hand, the learners in the finger-touching learning group have to hold a tablet PC and use only their fingers for all operations. Participants’ learning performance was evaluated through tests of factual knowledge and procedural knowledge. The result shows that the body-moving learning group outperformed the finger-touching learning group on speed in the factual knowledge test and projectile angle in procedure knowledge test. No significant difference was found in the rest of test items.

Keywords: Embodied cognition, embodiment-based learning, natural user interface, elementary gamification activities, projectile motion

1. Introduction

Literature of embodied cognition suggests that human cognition consists of mental model simulation, environment, situated action and bodily state (Barsalou, 2008, 2010; Lankoski & Järvelä, 2012; Rambusch, 2006). Learning with the support of body movements, external perception, and environment information is helpful for internal knowledge construction (Arjoranta, 2013; Barsalou, 2010). Pointing gestures, representational gestures, and metaphoric gestures can be exploited for enhancing memorization and improving comprehension (Martha W. Alibali & Nathan, 2012). Macedonia, Müller, and Friederici (2011) found that iconic gestures can better facilitate language learning than meaningless gestures. Currently, learners usually interact with most learning systems through physical controllers and mobile devices such as mouse, smartphone and tablet PC. However, the controller-based interaction is limited to provide enough external perception for a clear understanding when learning abstract concepts in natural science subjects.

Previous research suggests that learning with adequate strategies and technologies can facilitate learners’ comprehension of abstract concepts, knowledge construction, and learning performance improvements. Educational computer games can motivate learners, draw their attention on learning content, and improve their learning outcome (Cagiltay, 2007; Tüzün, Yılmaz-Soylu, Karakuş, İnal, & Kizilkaya, 2009). For example, Sung and Hwang (2013) designed a collaborative game with a grid-based Mindtool for elementary school students to learn characteristics of plants and the learners obtained improved learning achievement. The learners’ attitudes, motivation, academic record, and self-efficacy were better promoted after playing the game. Howison, Trninic, Reinholz, and Abrahamson (2011) utilized Wii Remote controller to provide gesture-based interaction between learners and learning system and help the learners learn the concept of numerators and denominators. Learning with such kind interaction by using body movements can help learners deal with the cognitive conflict...
between their thoughts and observational operations for better comprehension. Hao et al. (2010) utilized a webcam to develop a Wii-like, vision-based motion game for learning the stroke order of Chinese characters. The result shows that learners can memorize well the stroke order of Chinese characters and achieve better learning outcomes. The interaction between a learner and a learning system is depended on the design and representation of learning materials. Also, simulation is a form of interactive multimedia. For example, a virtual laboratory can be created and simulated for an experimental process without imposing any physical dangers on learners (Annetta et al., 2014).

Learners can have authentic understanding if they actually conduct a natural science experiment and experience everything that occurs with their own bodies during the experimental process. From the perspective of embodied cognition, external perception and internal mental model simulation both contribute to create cognition. Learning by doing is a practical method and can make learners situate in a rich context. During the learning process, learners’ body movements can help them to understand the learning content with a reflection of previous learning and daily life experience (Anastopoulou, Sharples, & Baber, 2011; Shapiro, 2014). For example, with the body participation, multimedia materials, and simulation exercises, learners can successfully bridge the gap of abstract concept and real world to learn fundamental optics better (Hung, Lin, Fang, & Chen, 2014). Chao, Huang, Fang, and Chen (2013) successfully improved learners’ memorization of English vocabulary and phrases by using a gesture-based learning system. Kuo, Hsu, Fang, and Chen (2014) implemented total physical response (TPR) approach with an embodiment-based design to facilitate English vocabulary learning. The result shows that the retention of the learners in the embodiment-based TPR group was better than those in the conventional TPR group.

This study applied technologies of natural user interface to design gamification activities for learning the fundamental projectile motion of physics. Another aim of the study was to test if the learners are able to transform what they have learned into real-life practices and applications.

2. System Design

Projectile is an object projected by external force. Projectile motion describes the process regarding how the projectile moves, and it can be easily observed in people’s daily life. In this study, the learning content is fundamental projectile motion of physics including two learning goals. The first one is how the projectile parameters change in terms of the moving distance and the angle when the initial speed is fixed. The second one is how the projectile parameters change in terms of the moving distance and the initial speed when the angle is fixed.

After considering the learning goals and the age of the target learners, the Angry Birds game is exploited to design an elementary gamification activity. Based on embodied cognition, education computer games can be implemented with a role-playing feature and the players can link the gaming experience with their daily lives (Lankoski & Järvelä, 2012). The gaming events and operations in the Angry Birds game are consistent with the learners’ daily experiences and the knowledge behind the game regards fundamental projectile motion of physics.

Based on the perspective of embodied cognition, this study utilizes technologies of natural user interface to make learners be able to interact with the learning system through their body movements. The Angry Birds game is adopted to convey the abstract concept of fundamental projectile motion with learners’ body-moving experience. In Figure 1 (a), the body-moving learning system consists of a Microsoft Kinect sensor, a laptop, and a big display. The Microsoft Kinect sensor was used to build the learning environment capable of sensing learners’ movements. The learning system was developed in C# and executed with the Angry Birds PC game on the laptop (Figure 1 (b)). The external display is to provide learners a big visual area for watching the game details because the learners have to stand in front of the sensor about 2–3 meters and the laptop screen is too small.

Three gestures were designed for playing the game to enable learners to simulate the process of projectile motion. First one is that learners swing their right hand at different speed to control the projectile initial speed. Another one is that learners raise their left hand at different height to adjust the projectile angle. The last one is that learners raise both hands to confirm the adjustments regarding projectile initial speed and projectile angle, and then an angry bird is launched to hit targets. The top area of the system screenshot provides learners operational guides with pictures and text to prompt related functionalities for game playing. When learners move their hands, this area instantly present every position changes of their hand skeletons. The bottom area is the game area of the Angry Birds.
The finger-touching learning system is the Angry Birds game which runs on a FIC Tycoon 10.1-inch multimedia tablet PC. All operations are finished by finger-touching. In this case, learners play the game according to the two learning goals. Compared to the body-moving learning, the finger-touching learning barely provides learners external perception related to the abstract concept of the learning content (Figure 2).

3 Method

This study applied technologies of natural user interface into elementary gamification activities for learning fundamental projectile motion. In order to evaluate learners’ performance, an experiment was conducted including the body-moving and finger-touching learning groups. Krathwohl (2002) proposed the structure of the knowledge dimension of the Revised Bloom’s Taxonomy including factual knowledge, concept knowledge, procedure knowledge, and metacognition knowledge. Factual knowledge regards the terminology of learning content that learners have to know. Procedure knowledge concerns that learners know how to apply what they have learned such as methods and skill. In body-moving learning group, learners can control the projectile initial speed by swinging their hands at different speed. When they want to have a high projectile initial speed, they need to swing their hand quickly. On the other hand, learners in the finger-touching learning group just move their finger to control the projectile initial speed which is only related to the finger position, not to the speed. Therefore, hypothesis 1 is proposed as “In fundamental projectile motion learning, the body-moving learning group has higher scores on the factual knowledge test than the finger-touching learning group”.

During the learning period, learners in the body-moving learning group can interact with the game objects in the learning system through their body movements. But learners in the finger-touching learning group can only interact with the game objects by moving their finger to different positions and touching the screen for confirmation. The body-moving learning group has external perception for knowledge construction than the finger-touching learning group. The body-moving learning group provides learners a learning context capable of interacting with the game objects and adjusting corresponding parameters through their body movements. Although learners in the finger-touching learning group can also interact with the game objects and adjust related parameters, the connection between knowledge and motor skill is not strong enough. Thus, hypothesis 2 is proposed as “In fundamental projectile motion learning, the body-moving learning group has higher scores on the procedural knowledge test in terms of projectile initial speed, angle, and motor skill than the finger-touching learning group”.

A total of 60 elementary school students from grades four to six were recruited to participate in this experiment at National Science and Technology Museum, Taiwan. 30 of the participants are male. The average age is 10.82 with 0.93 standard deviation. Participations were randomly and equally divided into the body-moving learning group and the finger-touching learning group followed by the
same instruction of fundamental projectile motion. After the experiment, every participations can get a gift as rewards.

The design of the tests of factual knowledge and procedural knowledge is based on the definitions of the structure of the knowledge dimension (Krathwohl, 2002). Factual knowledge was assessed by selecting related terms from eight keywords including sunshine, parabola, force, angle, speed, temperature, water, and weather. After the experiment, the participants have to answer what the keywords related to the learning of fundamental projectile motion.

The test of procedural knowledge includes the projectile methods and the motor skill to project an object to correct places. The projectile methods were assessed by a projectile motion simulation program from PhET (http://phet.colorado.edu) including projectile angle and projectile initial speed. The simulation program has been widely used in the educational field. The participants were asked to finish two parts. First part is to fix projectile angle, and the participations only change the value of projectile initial speed to make the object hit the target. Second part is to fix projectile initial speed, and the participants only change the value of projectile angle to make the object hit the target. The total scores for each part is 10. Each learner in each part is allowed to have ten tries. When the learner fails a try, the scores will be deducted one point and the worst case is zero. A screenshot of this test is shown in Figure 3(a).

In the evaluation of the motor skill, learners have to throw a ball and sees if they can hit the scoring area in real world (Figure 3(b)). Firstly, participations should stand on the starting point. The throwing gesture in the motor skill is requested to be identical with that in the gamification activity. This test has two part including near-end and far-end. The total score in each part is three points. A learner has two opportunities in each part for practicing and three tries for counting scores. In each part, there are five blocks, one for ten points, two for five points, and two for one point. If a learner throws the ball out of the five blocks, the learner only gets one point.

![Figure 3. Procedural knowledge test (a) projectile initial speed and angle; (b) motor skill](image)

Before the experiment, an instructor introduced the entire process to participants. At the beginning, a pre-test of procedural knowledge was conducted for five minutes. Then participants were randomly and equally divided into body-moving learning group and finger-touching learning group. Then, the learners in each group received corresponding instruction regarding the knowledge of fundamental projectile motion and the operation of the learning system for five minutes. In terms of learning system operation, each participant watched a demonstration of an instructor and had two opportunities to practice in person. Then, each participant started to perform the gamification activity for seven minutes. After the learning activity, a post-test of procedural knowledge was conducted for five minutes and the factual knowledge test was performed in two minutes. The pre-test and post-test of procedural knowledge is mostly the same only with different default parameters to avoid memorization effect. At the end of experiment, participants were requested to fill out a questionnaire in two minutes for collecting demographic data.

4 Results and Discussion

The descriptive statistic of the factual knowledge shows that most of participants chosen four keywords, namely parabola, force, angle, and speed. For hypothesis 1, an independent-sample t-test was used to test the difference between the body-moving learning group and the finger-touching learning group. This result shows that the body-moving learning group has better outcome in terms of speed than the finger-touching learning group ($t = 2.918, p < 0.01$). No significant difference was found in the other
seven keywords. The participants in the body-moving learning group have to swing their hand to control the projectile initial speed. The projectile initial speed reflects on how quick the learners swing their hand. Therefore, the learners can have a strong impression on speed. On the other hand, the learners in the finger-touching learning group just move their finger on the screen of the tablet PC and no related external clues can make their thinking associated with speed.

For hypothesis 2, this study used independent-sample t-test to test the difference between the body-moving learning group and the finger-touching learning group. No significant differences were found in the result of the pre-test which suggests that all participants in this experiment do not have significant differences of procedural knowledge in terms of projectile angle, projectile initial speed, and motor skill. The result of the post-test is shows in Table 1. The body-moving learning group has significantly higher scores of projectile angle than the finger-touching learning group ($t = 2.189, p < 0.05$). No significant differences were found in terms of the projectile initial speed and the motor skill.

Table 1: Independent-sample t-test result of procedural knowledge.

<table>
<thead>
<tr>
<th>Type</th>
<th>Body-moving learning group (N=30)</th>
<th>Finger-touching learning group (N=30)</th>
<th>$t (p)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projectile angle</td>
<td>7.33 (1.688)</td>
<td>6.37 (1.732)</td>
<td>2.189* (0.033)</td>
</tr>
<tr>
<td>Projectile initial speed</td>
<td>7.37 (1.629)</td>
<td>7.73 (1.413)</td>
<td>-0.931 (0.356)</td>
</tr>
<tr>
<td>Motor skill</td>
<td>44.80 (9.925)</td>
<td>44.63 (7.712)</td>
<td>0.073 (0.942)</td>
</tr>
</tbody>
</table>

*$ p < 0.05$

The result of procedural knowledge does not fully consist with the hypothesis 2. Two probable explanations are addressed in this study. The first one is that the design of the Angry Birds game which only emphasizes the adjustment of the projectile angle, not the adjustment of both projectile angle and projectile initial speed. The body-moving learning system can reflect the speed of swing a hand on the projectile initial speed in the game. By reviewing the video recording, most of the learners in the body-moving learning group would rather swing their hand at high speed than at low speed. The same situation also occurred in the finger-touching learning group. Therefore, it may affect the result of the procedural knowledge. The other explanation is that the elementary school student is too young to have an adult-like mature cognitive development. The embodiment-based design can facilitate learners to link body movements with the game objects and parameters. However, the young learners have difficulty to transform such experience from what they learned into real practices and applications because the gamification activity was performed in a third-person view. The motor skill was assessed in a first-person view. Thus, the young learners could not deal with the change of viewpoints well, and the outcome of motor skill is likely to be interfered.

5 Conclusion

This study exploits the Angry Birds game to provide elementary students gamification activities and improve their learning of fundamental projectile motion through an embodied approach. According to the results, the body-moving learning group outperformed the finger-touching learning group on speed in factual knowledge test and projectile angle in procedure knowledge test. These results have already shed light on the potential of gamification activities to learn factual knowledge and procedure knowledge of subjects. Although not all test items are significant, the learners in the body-moving learning group certainly obtain improvements on speed in factual knowledge and projectile angle in procedure knowledge. This study designs the gamification activities which can be accomplished in just seven minutes. Short period gamification activities are fairly appropriate for learning in field trips such as a part of educational exercises in a museum. Because the cognitive development of young learners is still in progress, the gaming experience can motivate them and learning by doing is also one good practice for digital game enhanced learning. One research limitation in this study is the fixed third-person viewpoint of playing the game because the off-the-shelf commercial game was used. Although the body-moving learning can link body movements with the game objects and parameters, the learning outcomes would be affected by the extent of learners’ cognitive development. Instructors and
researchers have to take care of the issue of viewpoint changes for young learners when designing an embodiment-based learning system.

Acknowledgements

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References


SHIVA: Virtual Sculpting and 3D Printing for Disabled Children

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Abstract: In this paper we present the SHIVA project which was designed to provide virtual sculpting tools for children with complex disabilities, to allow them to engage with artistic and creative activities that they might otherwise never be able to access. Modern 3D printing then allows us to physically build their creations. To achieve this, we combined our expertise in education, accessible technology, user interfaces and geometric modelling. We built a generic accessible graphical user interface (GUI), a suitable geometric modelling system and used these to produce two prototype modelling systems. These tools were deployed in a school for students with disabilities and are being used for a variety of educational purposes. In this paper, we present the project's motivations, approach and implementation details together with initial results, including 3D printed objects designed by children with disabilities.

Keywords: Virtual Sculpting, Accessibility, User Interfaces, Disabilities, 3D Printing

1. Introduction

Artistic activities are an important educational subject in their own right and can also provide strong links with other core subjects and life-skills such as spatial awareness, object recognition, as well as aspects such as self-expression and building self-confidence (Rubin, 2001). However, using clay or other sculpting materials is non-trivial for individuals with complex disabilities, as well as raising practical issues such as hygiene, dust, equipment, storage, and so on. In the SHIVA (Sculpture for Health-care: Interaction and Virtual Art in 3D) project, we proposed to use ICT to extend access to artistic tools within a fully protected environment, for vulnerable groups: people in rehabilitation (through French partners in Lille and the HOPALE Foundation) and children with various types of disabilities (by the authors in the UK at Bournemouth University (BU) and Victoria Education Centre (VEC)). In this paper we present the motivations, approach and initial results of the SHIVA project's use with children.

Young people with disabilities may have a very different experience of the physical world to those without (Tumbull, 2011). This experience may be influenced by their range of movement, coarse or fine motor control, or having spent their life in a wheelchair. New technologies are helping to provide ways in which young people who have disabilities can have the experience of the physical world in a virtual sense. Thus, the aim of the SHIVA project was to enable such young people to learn about manipulating objects by providing a few basic virtual sculpting tools and then producing the objects physically with 3D printing technologies.

The primary goals for the project were to give school students the opportunity to be creative and to produce physical artefacts which would otherwise not be possible for them by developing software tools. Artistic creativity was chosen for its well documented educational applications and benefits (Rubin, 2001) and the geometric modelling approach has similar parallels to the concepts of active learning and constructivism. So, the primary research objectives were: 1) to establish the ranges of interface requirements needed by children with disabilities; 2) to develop a generic accessible user interface system to meet these requirements and 3) to develop appropriate virtual sculpting methods, built on an accessible interface, and allowing 3D printing for real-world output.
2. Previous Work

2.1 User Models and Accessible User Interfaces

User interfaces provide the software interface layer between the human user and the actual software application. Most computers currently support user input from keyboard, mouse, touchscreen and to some extent voice commands while most output modalities rely on information-rich visual displays, which can be difficult for the visually impaired. While some of the project's students can use a mouse or touchscreen, others struggle to press a single large button, or have absolutely no limb control and can only access software through an eye-gaze system.

Each individual user with disabilities has very different interface requirements which vary according to their physical or cognitive abilities and which are dynamic and liable to change, often throughout each day. The interface must store information about its users in order to be configured to their requirements. This is called a user model and can generally be stored in two ways: a medical approach, where information about the user’s medical and physical capabilities is stored; and a functional approach, where the user’s interface requirements are stored. The medical approach must always be interpreted by the system to translate this into actual needs of the user.

Specialist accessible interface toolkits are available to extend the limited interface adjustments available in operating systems. The Grid 2 (Sensory Software 2014) provides disabled access primarily for communication. The software covers a wide range of inputs and features, but is not open or flexible enough for a heavy-weight application such as interactive 3D modelling. The MyUI project (Peissner et al, 2012) has an adaptive interface but is targeted at elderly people for giving them access to simple utilities and consumables. The user profile is adjusted while the user is working with the system, however the actual input of profile data is not supported. Similarly, the GUIDE project (Jung et al, 2012) has a user-centred approach to create basic UIs with a large variety of input devices as well as accessibility options, but again, the project is primarily focussed on elderly users for simplifying access to entertainment and communication and the user profile which is set up by guiding the user through a simple test is somewhat limited and does not take into account input of the user data nor complex disabilities.

SHIVA was designed to build on such work for setting up the user profiles, but extending the concepts to provide more flexibility and support for heavy-weight content creation tools rather than just media consumption.

2.2 Virtual Sculpting for Disabled Users

Virtual (Digital) Sculpting is a computer-aided technology allowing for the creation of sculptural artefacts. It can be performed in various ways: using 2D/3D input with subsequent reconstruction, using a purely mathematical description, using an interactive modelling technique that employs pressure-sensitive or haptic interactions, or alternatively, using a set of virtual reality interface tools such as cybergloves or Digital Clay.

The concept of Virtual Clay (McDonnell et al, 2001) is perhaps the most natural metaphor for virtual sculpting. It is supported by a number of commercial and research products such as Geomagic Freeform and Claytools, Cubify Sculpt, Pixologic’s ZBrush and Sculptris.

Interactive local modifications can also be performed using different sculpting metaphors. In the Augmented Sculpture Project by the SHIVA team (Adzhiev et al, 2005) a specific interactive environment with embedded sculptural means was created. The user experiences an immersion into a virtual space where they can generate new shapes using either metamorphosis between several predefined sculpture models or the virtual carving tool with such operations as subtraction, offsetting and blending. Finally the resulting sculpting artefacts were 3D-printed to produce new physical sculptures. The project had both artistic and educational merits and the tools and lessons learned fed directly into the SHIVA project, especially the use of the group’s scalar field or Function Representation (FRep) based modelling system due to its feature set and natural 3D printing suitability.
3. Approach

3.1 Accessible Graphical User Interface (GUI)

To achieve the objectives of the SHIVA project a new accessible interface was needed which could cater for the broad interface requirements of users with complex disabilities. A functional user modelling approach was determined the most suitable because it directly maps the user's interface needs with the software settings. The input mode and specific settings are stored in a user profile which is created for each individual student and which can also be transferred between different software prototypes that use the interface.

The user's physical needs were identified in a way that focussed on the direct interface requirements and their ranges. This informed the development of a generic graphical user interface (GUI) system to map all sculpting features to on-screen 'buttons'. All interface devices and modalities could then be successfully employed. Single button access is possible with switch-scanning (Colven & Judge 2006), where each GUI button is highlighted in turn until the user presses their switch to select the current element. This approach gives full access, regardless of physical input requirements.

The final SHIVA GUI system features include: switch-scanning with adjustable timing, direct progression with multiple switches; mouse or touchscreen control; button debouncing; key-mapping with activation on trailing or leading edges; basic eye-gaze support with adjustable dwell time and configurable rest zones; fully configurable GUI layouts which can be saved and loaded from user profile; visual styling across multiple profiles; visual adjustment in themes and profiles; configurable graphics for buttons, symbols, text, including sophisticated colour replacement in graphics.

3.2 Shape Modelling System Core

The third research objective was to allow the users to sculpt virtual objects and in our system we use a geometric representation in implicit form through Function Representation (Pasko et al, 1995). This allows us to describe a vast number of geometric primitives and perform many operations in a simple and efficient way compared to other traditional representations, such as polygonal meshes. Easy formulation allows us to work with traditional geometric primitives such as a sphere, box and cylinder. Beyond this, more complex geometric primitives such as polygonal meshes can be represented efficiently in the form of signed distance fields (Sanchez et al, 2012) which is a natural subset of Function Representation. Traditionally, the disadvantage of such a representation is that the geometry cannot be rendered using the standard interface for graphics hardware. In our system we visualise objects with real-time ray-casting on graphics hardware (Fryazinov and Pasko 2008).

The objects and operations are represented in the form of a tree that generates the defining function for the model. In the leaves of such a tree we have the geometric primitives and objects, while in the nodes we have operations over other nodes and leaves (Pasko et al, 1995). This allows us to perform operations in the modelling system by modifying the structure of the tree itself by adding and removing nodes.

As an intermediate format for the geometry we are using the volumetric object format developed by the Norwegian company Uformia. This supports most of the operations and primitives existing in the current state of the art in modelling with geometry represented in an implicit form. For 3D printing we must convert to a polygonal mesh.

4. Applications

4.1 Metamorphosis Prototype

The first prototype software developed by BU in collaboration with VEC and using the accessible GUI was a metamorphosis exercise, specifically for younger or less cognitively able students. Here, the user chooses two objects and can produce an intermediate shape that is a blend between the two objects. Interaction for this is through a slider and the blended shape is displayed to the user and
updated interactively. The user can then rotate their object and apply a colour to it. The relatively simplistic interface is shown in Figure 1.

![Figure 1. The metamorphosis prototype, with button layouts designed with VEC participation. The student chooses two models, can make a blend between them, and then colour the resulting shape. A blend between a sheep and a frog model is shown.]

From the geometric point of view, in the application we perform metamorphosis operations over two FRep objects which can be seen as a linear interpolation between the values of the scalar field for the initial object and the target object, and we have tried more complex metamorphosis operations (Sanchez et al. 2013). We used polygonal meshes of existing real-world objects converted to scalar fields as sources for the input shapes. The output of the application is the solid object representing the intermediate stage of the metamorphosis between two objects. The resulting object is a solid model and can be used for fabrication (3D printing).

### 4.2 Totem Prototype

![Figure 2. The totem-pole prototype interface. Left: main construction screen with buttons to add primitive geometric shapes to the stack, navigation buttons and a designed shape showing primitive stacking, blending and drilling. Right: drill operation screen with cross-hair controls for drill location and controls to rotate the object.]

The second software prototype from BU was a 'totem-pole' exercise, which provides a more complex sculpting environment. Here, the user stacks a small number of objects together and then performs simple modelling operations such as affine transformations on individual objects within the stack, or operations such as blending and drilling on the entire stack. For this application the accessible UI is necessarily more advanced (Figure 2). We currently allow the user to choose from a number of simple geometric shapes as an input: sphere, box, cylinder and cone. The set of operations over these objects include: Boolean operations (union, and subtraction), smooth union blending between objects, and affine transformations. From the implementation point of view the operations are achieved by modifying the tree representing the object.
5. Results

Some students were invited to try the software during the development phase in 2013. This was introduced to them in a careful and controlled manner because their reaction to potentially unstable prototype software was unknown. In reality, the students were extremely enthusiastic and took particular delight in the discovery of software bugs which was useful to the development team and gave the students a sense of value in their participation. Overall student engagement has been exceptionally high, with all participating students showing a great deal of enthusiasm. The software prototypes were installed at VEC and used by eleven students including two eye-gaze users. Students successfully produced a range of objects (Figure 3), validating the software and the process.

The SHIVA software has been successfully used to help teach students about spatial relationships between objects and general spatial awareness, including concepts such as 'up' and 'down', 'behind', 'rotate' and so on. This has also been useful to check comprehension and helped to identify two eye-gaze users who had similar difficulties with the concept of a 'stack' of objects. Teachers used a physical stack of objects and asked the users to reproduce the stack using the software. In the SHIVA Totem software objects are added in a stack which starts from the bottom, adding one object on top of the other. However, both eye-gaze users would consistently try to start the stack from the topmost shape first. It is unclear if their approach was a result of the way the task was presented to the students, but we hypothesise that because these users have simply never had the experience of physically placing one object upon another, the concept was quite new to them. Regardless of the causes, the identification of this has helped the teachers in their understanding of which fundamental spatial concepts need to be taught and reinforced with such students.

The software is used to help students understand how the shape of an object may be constructed from a set of simple primitive shapes and understanding the differences between and representations of 2D and 3D shapes. One popular teaching exercise is for the student to reproduce a drawn shape using the SHIVA software. Emphasis is placed on enjoying the experience rather than producing a ‘correct’ result and some students have already shown progress – one student who started with creating random objects is now creating identifiable objects such as a cat or a teddy-bear.

Speech therapists at VEC have successfully used the software with students in their regular activities to help with speaking and listening and cognitive development by working on concepts of sequencing, following instructions, communicating ideas and collaborative work. Early observations suggest the students’ enthusiasm for the software will lead to good results.

The SHIVA software is now being used in regular scheduled art lessons at VEC. A ‘shoe-box landscape’ project inspired by the work of British sculptor Andy Goldsworthy involves students creating sculptural arches as viewing windows similar to some of his famous works.

Therapists are also starting to use the software as a tool from the point of view of an aid in improving manual dexterity, or through a touch-screen interface to gradually encourage students to increase their range of movement by allowing them to reach for more distant input controls.
6. Conclusions and Future Work

In this paper we presented the SHIVA project, which was designed to allow disabled children to produce virtual sculptures and then use 3D printing technologies to fabricate these. To achieve this, we established research questions to identify and address interface requirements and to identify and develop appropriate virtual sculpting.

The interface requirements were identified and described with a functional user model, resulting in user profiles that stored each individual's interface settings for a new purpose-built GUI system. We coupled this with a Function Representation (FRep) modelling system to develop two prototype software applications aimed at different cognitive levels, which gave virtual sculpting capabilities to users with disabilities through the accessible GUI.

While formal user-studies and longer term developmental studies will be useful to quantitatively identify any educational benefits, from the perspective of the school simply giving a child with no limb control the ability to create a physical sculpture for the first time in their life is a far more powerful incentive and one where the real emotional and motivational benefits are far greater yet not as easy to measure.

Moving forwards for future work, the SHIVA software prototypes provided a small subset of modelling features. A more flexible system would be desired for more advanced users including adults. The SHIVA GUI represented a state-of-the-art prototype system, but a number of open questions remain, including: lower requirement on technical staff for profile creation; automatic user adaptation; support for further input modalities: brain computer interface, gesture, multi-touch, tablet; and flexible input mapping from multiple modalities. The inclusion of all these aspects would allow the software to be used by individuals with a broader range of disabilities and would make setting up and maintaining the software easier.

Acknowledgements

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References


Inferred Learning Strategy in Two-User-One-Computer Environment Study from Cognitive Style Perspective

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Abstract: Prediction-observation-explanation (POE) inquiry approach has been proven as a useful approach in helping students to inquire and to understand the subject deeply. Computer has demonstrated its power on simulation which can simulate a lot of environment. Combining the POE model and the computer simulation power, the authors propose an extended model named PSOE which represents prediction-simulation-observation-explanation model. A simulation APP game, “Newton’s Miracle,” was implemented to test the PSOE model. To explore the APP game usability on different cognitive styles students, an experiment was conducted in which fifty-six 8th grade students were involved. The experimental results indicate that the students’ learning achievement has improved, and the field independent and the low achievement students perceive more learning achievement from the APP game.

Keywords: Prediction, inquiry-based learning, game-based learning, cognitive styles

1. Introduction

In mobile devices supported classroom design, a straightforward thought is to equip each kid with one mobile device. However, classrooms are the place where students have their peers to interact with. We will argue that letting two students to share one computer can help to enhance their interaction, and to attract their discussion and understand on the learning subject. In this study, the authors adopt two-user-one-computer design approach which means two students use one computer face-to-face together to design a PSOE (prediction-simulation-observation-explanation) game. PSOE is extended from POE (prediction-observation-explanation) model (Hong, Hwang, Liu, Ho and Chen, 2014). In the PSOE environment, one of the paired students firstly proposes a question, the other student predicts the result consequently. Once both of them agree the proposed question and the proposed prediction result, the computer then simulate the results to test the proposed prediction result. The students then compare the differences among the prediction and the simulation results and give a reasonable explanation. To exam the PSOE concept mentioned above, the authors implemented a two-user-one-computer simulation APP game named “Newton’s Miracle.” Besides, to study the system more systemically, the field dependent (FD) and field independent (FI) cognitive styles were considered to investigate different cognitive styles students’ responses on the “Newton’s Miracle” game. An experiment which involved fifty-six students was conducted to test the APP game. The results indicated that the game was helpful for the students to improve their subject understanding especially for the FI students and low achievement students.

2. Method

2.1 “Newton’s Miracle” System Introduction

In this study, the authors developed a two-user-one-computer simulation game named “Newton’s Miracle” which is an inferred learning strategy tablet APP game. The game is a paired game which
means two students play the game together. In the game, one of students plays the environment arrangement role setting the simulation environment, and the other one plays the prediction role predicting the simulation results. The subject of the game is Newton’s Laws of Motion. As shown in Figure 1, at beginning of the game, one of the paired students sets the values including the power of the force, and the force angle on the ball. The other student then needs to predict the movement of the ball. After both of the students complete the parameters settings and the result prediction, a physical simulation software engine is used to simulate the settings, and simulates physical simulation result. The game then calculates the score in this turn. The more accuracy rate the prediction, the higher scores the participant win. After complete a round, the paired students exchange their roles and start next round until one participant’s score is higher than 100. Students can directly understand the Newton's Laws of Motion through computer simulation.

![Figure 1. Newton’s Miracle System Screenshots.](image)

2.2 Participants and Research Instrument

Fifty-six 8th grade students from a junior high school students in Taiwan took part in this study. Among them 27 were males and 29 were females. Due to taking into account the fairness, the homogenous grouping strategy was adopted in this study. More specifically, two students with a similar level of prior achievement and same cognitive styles were formed as a group according to the results of the measurement of cognitive styles and pre-test. The participants all had the basic knowledge about Newton’s Laws of Motion and didn’t have any experience about computer simulation course. The experimental procedure is composed of five steps. They are preliminary training, cognitive style measurement, pre-test, interactions with “Newton’s Miracle” system, and post-test.

The preliminary study took five days and forty minutes per day. On the first day, the participants were initially trained to know how to play the “Newton’s Miracle” game, involved to do cognitive style measurement and the pre-test of the Newton's Laws of Motion. The cognitive style dimension investigated in this study was the level of field dependence. The group Embedded Figures Test (GEFT) is used in the study (Witkin, Oltman, Raskin and Karp, 1971). The GEFT reliability ($\alpha=.82$) is properly and frequently utilized instrument to measure an individual’s degree of field dependence (Hong, Hwang, Tam, Lai, & Liu, 2012). Two similar pre-test and post-test tests were designed by a junior high school science teacher who was familiar with Newton’s Laws of Motion. The pre-test and post-test were common physical movement phenomenon of life based on Newton’s Laws of Motion. The total score of the pre-test and post-test of the Newton’s Laws of Motion was 100. Among the 56 participants, 16 were measured as FI and 22 as FD. We also classified students to high achievement group and low achievement group by the score of pre-test. Among the students, 18 were measured as high achievement and 20 as low achievement. To ensure the participants’ correct use of the system, the researcher explained the operation of the system and demonstrated to them before they did the experiment. On the last day, after the experiment had finished, participant had post-test of Newton's Laws of Motion.

3. Preliminary Data Analysis

In this study, the independent variable was the cognitive styles (i.e. FI or FD). The dependent variables were the pre-test and post-test scores from the Newton’s Laws of Motion tests. In addition to the pre-test
and post-test scores, another dependent variable was the gain score, which was obtained by finding the differences between the pre-test scores and post-test scores.

The paired t-tests were carried out to test whether significant differences exist between pre-test and post-test for the 56 participants. In learning achievement of Newton's Laws of Motion, the mean score of pre-test was 46.07 and the mean score of post-test was 55.54. The result of paired sample t-test suggested that the mean score of post-test was significantly high than the mean of pre-test (t = -4.85, p < .05). The results suggested that the participants' score had significant improvement after playing “Newton’s Miracle” game. As shown in Table 1, there was a significant progress for the students. The preliminary findings indicated that the “Newton’s Miracle” system was helpful for the students to learn Newton's Laws of Motion.

Table 1: Pair sample t-test of learning achievement.

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>N</th>
<th>S.D.</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-test</td>
<td>46.07</td>
<td>56</td>
<td>15.57</td>
<td>-4.85*</td>
<td>.000</td>
</tr>
<tr>
<td>Post-test</td>
<td>55.54</td>
<td>56</td>
<td>17.93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.5

To further analyze the data, the differences of learning achievement and cognitive styles of participants were involved. The statistics of the results were listed in Table 2. The data indicates that all the participants had improvement in the subject, especially the FI students whoever they were high achievement or low achievement students. Besides, the low achievement students, in general, have a lot of improvement on the learning subject. This is a preliminary study. The reasons causing those effects still need further study.

Table2: Descriptive statistics analysis of learning achievement.

<table>
<thead>
<tr>
<th>Learning achievement</th>
<th>N</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD group Low achievement</td>
<td>12</td>
<td>32.08</td>
<td>44.58</td>
<td>7.50</td>
</tr>
<tr>
<td>FD group High achievement</td>
<td>10</td>
<td>56.00</td>
<td>60.00</td>
<td>4.00</td>
</tr>
<tr>
<td>FI group Low achievement</td>
<td>8</td>
<td>40.00</td>
<td>59.38</td>
<td>19.38</td>
</tr>
<tr>
<td>FI group High achievement</td>
<td>8</td>
<td>60.63</td>
<td>72.50</td>
<td>11.87</td>
</tr>
</tbody>
</table>

4. Conclusions and Discussion

In this study, based on POE model, an extended PSOE model which including prediction, simulation, observation and explanation learning activities was proposed. To test the PSOE model, a simulation game named “Newton’s Miracle” was implemented. The subject of the system was Newton's Laws of Motion. In the system, two students can play the simulation game together face-to-face simultaneously. According to experiment results, the participants completed PSOE interactive learning activity showed that their scores had increased significantly. Meanwhile, the FI students and low achievement students had higher improvement than high achievement students. This is just a preliminary study. The system and the evaluation process still have a lot of room to improve.

References

Can time perception be affected by interactive comics?

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Abstract: In this paper, we describe our ongoing work towards understanding how interactive comics could affect time perception. An interactive comic story, The Dreaming Wine, has been created based on our current understanding of interactive comics, time perception and the relation between both. As a starting point for our research, we conducted an experiment on whether the amount of panels would affect the time perception of the comic reader. A list of principles was applied in splitting comic panels. The findings of the experiment are expected to provide a better understanding of how panels in interactive comics have an effect on the reader’s time perception.

Keywords: Time perception, interactive comics, panel

1. Introduction

Time perception plays a crucial role in many aspects such as consciousness, memory of the past and future, and more (Grondin, 2010). These aspects are related to learning. In this paper we are interested in time perception, learning and the role interactive comics could play here, as one of the most important attributes of comics is sequentiality (Eisner, 1985; McCloud, 1993) which means it contains “time”. We consider that there are at least four kinds of “time” in (interactive) comics: 1) real time in reality, 2) perception of the time in reality, 3) time in a story, and 4) perception of the time in the story.

Comics as a visual information and communication medium have been used in education and training related fields (Gordon, 2006; Mallia, 2007; Tatalovic, 2009). Comics are convenient for translating information into visual language at a relatively low cost. Along with the growing popularity of electronic devices, comics reading behavior migrates from paper-based to digital forms. Comics with designed interactivity can provide space for expression and reaching more engagement of the reader. However, research shows that people still prefer paper as a medium for reading, especially in-depth reading (Liu, 2005). Thus, how to design interactive comics to affect time perception in order to facilitate reading and learning is a relevant question for comic producers and educators.

2. Interactive Comics -- The Dreaming Wine

In order to study interactive comics, we created an interactive comic called The Dreaming Wine. Its story is adapted from an ancient Chinese legend recorded in “In Search of the Supernatural”. The original story is about a man named LIU Xuanshi who got drunk by a strong wine called One Thousand Days Intoxication produced by a famous wine maker DI Xi. We found that this story contains valuable concepts of time. The reason why LIU got drunk for that long might be because he got lost in his own intoxicated illusion. Our main adaptation is that we added a “dream world” to the story to visually emphasize this illusion. By creating “the dream world”, we create space for different time concepts and expressions. Comparing to the “the real world” in the story, “the dream world” contains unusual narrative time and visual expressions.
2.1 Story structure
The plot of the story contains mainly 3 parts: events in the “real world”, events in “the dream world” and events back to the “real world”. The finished comic story (Figure 1) contains 20 pages with 104 panels in black and white. See Table 1 for the page and panel distribution according to this plot:

![Sample comic pages](image1)

Table 1: Page and panel distribution.

<table>
<thead>
<tr>
<th>Page No.</th>
<th>Events in the “real world”</th>
<th>Events in “the dream world”</th>
<th>Back to the “real world”</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td></td>
<td>6-13</td>
<td>14-20</td>
</tr>
<tr>
<td>001-025</td>
<td></td>
<td>026-068</td>
<td>069-104</td>
</tr>
</tbody>
</table>

2.2 Experimenting with panels
There are several factors that can influence the reader’s time perception in reading interactive comics, such as panel arrangement, narrative and interactivity. Cohn (Cohn, 2013) divided comic strips into units, visualized as panels or combinations of panels. One of our assumptions is that the reader’s time perception can be affected by the amount of the panels in comics. To experiment with this assumption, we have created a second version of “The Dreaming Wine”, a variation of the first version with more panels, by splitting the original panels but keeping the same context as much as possible.

2.2.1 Panel splitting
According to McCloud (1993) one single comic panel can possess a period of time. This means time in a panel is divisible, as a period of time can be divided into smaller periods of time. Under the premise of maintaining the same narrative, the same amount of visual information and reading fluency, we tried to split the original comics with 104 panels into 173 panels, following these principles:

- Introduction, talking and thinking: can be split at possible transitions. (Figure 2A)
- Conversations inside a panel can be split at the turns. Chu et al. discussed how to optimize speech balloon according to number of words and emotion embedded in subtitles in their research of generating comics from videos (Chu & Yu, 2013). We adapted their conversation splitting methods in to this principle. See Figure 2B.
- Movements inside a panel can be split at the changes. See Figure 2C. Note: Onomatopoeia—visual words that indicates source of the sound. In comics, onomatopoeia usually happens when there is movement. Therefore, it can be seen as a sign of splitting.
- Silent moments: there are several panels that can be partially replicated to create silent moments. This kind of splitting is subjective and can be created either before or after the original panel. See Figure 2D.
- Exceptions: If the splitting influences clarity of image (mostly because the size of the original panel is already small), the panel shouldn’t be split. If there is conversation happening in introduction, to keep the introduction complete, the panel shouldn’t be split. See Figure 2E.

![Splitting principles](image2)

2.2.2 Experiment setting
We conducted a between-group experiment using the two variations of “The Dreaming Wine”. The
variable is the amount of panels. We used two versions of The Dreaming Wine: version A containing 104 panels, and version B containing 173 panels. The comic was shown on a tablet with limited interactivity, using a click left and right button on each side of the page to flip pages. Reading path and time spent on each page were recorded automatically, including flipping back. Each participant was invited to a quiet room (approximately 9 m²) with a table and chairs. In order to test time perception, each subject was asked to remove their watch and any other portable device that can tell time. Also, the visible clock on the experiment tablet was blocked. Each participant was informed about the basic information of the experiment, and asked to take time to read the comics to get the basic understanding of the story. In order to let participants get familiar with the experiment setting, they would interact with a three-pages training comic first. Then, each participant was asked to estimate 1 minute both before and after reading the formal comics, and also his/her estimation about how long he/she spent on reading. A questionnaire was used at the end of the experiment to check the participants’ understanding of the story, and an interview (recorded on audio) was conducted focused on individual reading performance. The experiment was conducted during 9:30-11:30 and 14:30-16:30 on workdays for two weeks with forty participants in total. We collected data including: total reading time, time spend on each page, reading path (whether there is a read back event), 1 minute estimation before and after reading, reading time estimation of the participant, and story (information) comprehension of the participant.

3. Discussion

We observed several facts that could be important for further research: 1) Reading back event happens often when switching from “the dream world” to “real world”; 2) Some people are more sensitive to verbal information while some are more to image information in the context of comics; 3) People tend to set up their own standing point based on time information shown in the comics to build a time line, the time information can be word and/or image that indicate time; 4) The influence of different amounts of panels is unclear, while time spent on each page does clearly differ. We will conduct further analysis combined with questionnaire and interview data. We believe that in order to study the effect of panels within interactive comics, not only time spent for each page but also time spent for each panel should be recorded, which could mean including eye-tracking in a follow-up experiment.

Acknowledgements
This research is supported by the Chinese Scholarship Council and facilitated by Eindhoven University of Technology.

References
Subjective Evaluation of Stereoscopic View in Immersive Projection Display

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Abstract: We made a subjective evaluation of stereoscopic views in an immersive projection display. This kind of display has been used for exhibiting virtual reality content in learning facilities such as science museums and cultural centers. They require space and time that differ from those in daily life. The immersive projection display may provide us with the sense of presence by stereoscopic images with a wide field of view. We performed an experiment to compare stereoscopic images with normal images in moving around in the virtual world. The results of the subjective evaluation suggested that the virtual objects placed near a user looked three dimensional more in the stereoscopic views, and the sense of presence was provided sufficiently even in the normal views.

Keywords: Immersive projection display, stereoscopic view, evaluation, virtual reality

1. Introduction

Since an immersive projection display has been proposed as a CAVE system (Cruz-Neira, Sandin, & DeFanti, 1993), many systems have been applied as a virtual reality environment to learning facilities such as science museums and cultural centers. The typical CAVE system consists of four screens with three sided walls and a floor forming a cubic screen. Stereoscopic images are projected to each screen so as to be seamlessly seen from a user’s point of view, achieving a wide viewing angle. It enables the user to be given the sense of presence at a high level.

When new media are used for learning, the performance gains in the initial period of time (Clark, 1983). It is called the novelty effect. The novelty effect is convenient for learning environments such as science museums and cultural centers, because those environments are required to have space and time that differed from those in daily life (Bell, 2002). We believe that the immersive projection display has potential to provide the space and time that differ from those in daily life. It is not clarified what elements of the immersive projection display affect the user’s experiences, though there have been the researches on effects of large displays (e.g., Tan, et al., 2006) and stereoscopic displays (e.g., Willemsen, 2008) on task performance. Here, we investigate the effects of stereoscopic views on the sense of presence by a subjective evaluation in an immersive projection display.

2. System

Our immersive projection display was originally constructed as a CAVE-like system with a 5.5-surface cubic screen (Asai, Osawa, & Sugimoto, 1999). It was reconstructed with a PC cluster and freely available software (Asai & Takase, 2013). Only four out of five surfaces in the cubic screen were used as the projection display, as shown in Figure 1 (a). Stereoscopic images are projected by LCD projectors, and are separated to the left-eye and right-eye images through the circular polarization. The size of each square screen is 3 m by 3 m, and the projection resolution is 1000 by 1000 pixels. The stereoscopic images are generated by four PCs equipped with a GPU, which form a PC cluster through a gigabit Ethernet LAN. A wired game pad is used as a joystick for controlling the viewpoint in the virtual world. We developed an original application of moving around in the virtual tideland and observing various kinds of wild birds in the different period of year, as shown in Figure 1 (b).
3. Experiment

We performed an experiment to compare stereoscopic images with normal (two dimensional) images in viewing scenes of the virtual tideland world. Both stereoscopic and normal images were projected to the four screens (three walls and one floor), and no sound was generated during their experiences.

3.1 Methods

Nine participants were the BA and BS students who gathered from different universities. The participants used the system for roughly 5 minutes in each condition on the stereoscopic and normal views. They were instructed to move around in the virtual tideland world. They were polled with a preference test after the use. The preference test includes 9 questions listed in Table 1. A five-point Likert scale was used in the preference test, ranging from 1=definitely disagree to 5=definitely agree. Open-ended comments were required to provide their opinions in using the immersive projection display for viewing the virtual tideland world.

Table 1: Questions in preference test in experiment.

<table>
<thead>
<tr>
<th>No.</th>
<th>Question items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The system responded smoothly.</td>
</tr>
<tr>
<td>2</td>
<td>The objects close to you looked three dimensional.</td>
</tr>
<tr>
<td>3</td>
<td>You distinguished the objects placed near and far.</td>
</tr>
<tr>
<td>4</td>
<td>The scenes were viewed with the depth feeling.</td>
</tr>
<tr>
<td>5</td>
<td>You were immersed in the virtual world.</td>
</tr>
<tr>
<td>6</td>
<td>Viewing scenes was interesting.</td>
</tr>
<tr>
<td>7</td>
<td>You felt something uncomfortable in viewing scenes.</td>
</tr>
<tr>
<td>8</td>
<td>It was suitable for viewing scenes for a long time.</td>
</tr>
<tr>
<td>9</td>
<td>You were tired in viewing scenes.</td>
</tr>
</tbody>
</table>

3.2 Results and Discussion

Results of the preference test are shown in Figure 2. The number in the horizontal axis corresponds to each question item, and the symbols a and b indicate the conditions of stereoscopic and normal views, respectively. The thin bar on each black and white column is the standard deviation. The results from a paired t-test obtained the tendency toward significant differences between the conditions in the question items 2 (t(8)=2.95, p<0.05), 3 (t(8)=2.53, p<0.05), 4 (t(8)=3.16, p<0.05), and 8 (t(8)=-2.68, p<0.05). The question no. 2 and 8 had large differences between the conditions in the average scores, and each
score differs largely between the participants. The question no. 3 and 4 had the significant differences between the conditions, but the scores stayed between 3 and 5 in the both conditions.

The result of the question no. 2 suggested that the objects close to him/her looked three dimensional more in the stereoscopic views than in the normal views, though it depended on the participants. The result of the question no. 8 suggested that the stereoscopic views were not so suitable for the long time use. We guessed that this result was influenced from the high speed of moving around in the virtual world, because four participants reported in the open-ended comments that they had a feeling similar to motion sickness due to the high speed movement. Although the tendency toward the significant differences was found in the question no. 3 and 4, the high scores in the both conditions may lead to the importance of the other parameters such as wide views, rather than the stereoscopic views. The high scores in the question no. 5 and 6 also suggest that the both stereoscopic and normal views have given the participants the immersive and enjoyable feelings that may bring learning effectiveness.

![Figure 2. Results of preference test in experiment (a: stereoscopic, b: normal).](image)

4. Summary

We made a subjective evaluation of stereoscopic views in an immersive projection display, comparing stereoscopic images with normal images in moving around in the virtual tideland world. The results of the subjective evaluation suggested that virtual objects placed near a user looked three dimensional more in the stereoscopic views, and the sense of presence was provided sufficiently even in the normal views.

References


Tangible Animal Companions in Traditional Chinese Character Learning

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Abstract: With the advance of tangible technology, more and more educational systems are enhanced. This paper describes how tangible technology could enhance animal companions in terms of human computer interaction. These potential advantages are further organized as three design considerations, which further underpin the development of tangible animal companions. The tangible animal companions are also applied to the learning activity of traditional Chinese characters for young students. By doing so, tangible technology in learning can be evaluated and advanced in the future.

Keywords: Tangible technology in learning, animal companion, Chinese character

1. Introduction

With the emergence of the tangible technology—users use their hands to manipulate some physical objects, and a computer system detects this to give appropriate feedback (Ullmer & Ishii, 2001; Ishii & Ullmer, 1997), tangible technology in learning has been devoted more and more research efforts. This might be due to the fact that tangible technology might benefit learning in two ways.

First, tangible technology could enrich students' learning experience by combining multiple sensorial media. From the perspective of history, new technologies (e.g., Multimedia, Internet, Mobile devices) always drive new educational applications, in which students are more engaged or have more joyful learning experiences. Tangible technology emphasizes manipulating physical objects to learn, which can be further integrated with other multisensory approach (e.g., visual, auditory, kinesthetic, and tactile) and pedagogical strategies to benefit students' learning experience.

Second, tangible technology could advance students' thinking through learning-by-doing. From the perspective of tangible user interface, embodiment and metaphor are the two significant characteristics (Fishkin, 2004). The former means the tie relationship between input event (e.g., manipulation) and out event (e.g., feedback). For instance, the full embodiment means the entire state of the device is embodied within the system, which can focus students' attention. The latter refers to the comparison between the system effect and real-world effect performed by a user's action. For example, the full metaphor offers more affordances by physical shape, size, color, texture, or other features to invoke the metaphorical cues.

Previous studies have indicated that animal companions could enhance the human-computer interaction through developing emotional attachment with students (Chen, 2012). On the other hand, tangible technology has also been investigated to benefit students' interest and motivation. Along this line, tangible animal companions might maximize the effects of educational systems on student learning in different domain subjects. However, fewer studies investigate possible applications on different domain subjects. Thus, this study develops a tangible animal companion applied to the learning of traditional Chinese characters. Having this system, the influences of tangible animal companions system can be conducted in the future.

2. Tangible Animal Companion

2.1 Conceptual idea
The conceptual idea of tangible animal companion is underpinned by three design considerations: emotional attachment, learning companion, and tangible user interface. First of all, emotional attachment is regarded as one of the effective means to deepen the relationship between computers and students. For young students, their attachments to pets have been applied to enhance the interaction with educational agents (Chen, 2012). When students are more willing to care about their educational agents, the educational agents will have more chances to care about the system, which in turn drives the reciprocal caring and feedback between students and computers. Human-computer interaction is thus deepened and enhanced.

Next, learning companions are our design consideration from cognitive aspect. Learning companions refer to a pedagogical representation of virtual participants which learn and interact with students (Wolf, 2009). Based on the hypothesis of zone of proximal development—a distance between what a student has achieved and what the student can achieve when offered by appropriate social interactions with adults or more capable peers (Vygotsky, 1978), learning companions can offer appropriate scaffoldings to interact with students, and facilitate the zone of proximal development.

Finally, interface is the channel that determines how many power or benefits students can gain from computer systems, including educational systems. Different from virtual user interface, tangible user interface can empower the potential advantages of the former two considerations (i.e., emotional attachment and learning companions). More specifically, tangible user interface is helpful to the establishment of the emotional attachment to animal companions. When students can use their hands to touch their animal companions or take a physical ball to play with them, the students’ perception on the pet ownership and psychological supporting could be enhanced. This will help students develop close relationship with their animal companions. Therefore, the tangible technology (e.g., touch-based petting or combing for their pets) can foster the establishment of the emotional attachment. In addition, tangible user interface can integrate many interaction technologies (e.g., virtual reality, augmented reality, or mixed reality) as multisensory interaction, which could enhance students’ motivation and learning performance.

2.2 Implementation

The implementation of the pet dragon system involves different sensors and devices, including magnet/magnetic sensor, vibration sensor, QR code/WebCam, and buttons (see Figure 1). These sensor and devices are embedded in the pet dragon, a stuffed toy in the shape of dragon. In addition, the pet dragon is also connected to the computer so that some complex or detailed information (e.g., learning materials and feedbacks) can be illustrated on the computer screen.

The learning activity can be divided into three phases: nurturing, learning, and challenging (see Figure 2). In the nurturing phase, a student can see his/her pet dragon in the My Home. The goal of the...
student is to establish emotional attachment by taking good care of his/her pet dragon, which is a stuffed toy and the student can touch its head or play a ball with the pet dragon. This function is realized by different sensors and Arduino. These interactive behaviors will influence the dragon whose status is illustrated on the computer screen. In other words, the student can observe the status of the dragon and interact with it.

In the learning phase, the student can strengthen the pet dragon’s power by feeding traditional Chinese characters. The goal of the student is to learn more traditional Chinese characters, and then have more opportunities to review what he/she has learned by feeding the dragon correct Chinese characters in the My School. This intention is realized by the character cards with QR codes and WebCam in the pet dragon. When the student takes the correct character card matching the given question on the computer screen, the computer will show the feedback.

In the challenging phase, the student can challenge a series of levels with the pet dragon in the My Arena. The goal of the student is to compete against different opponents in the levels. The activity model in this phase is similar with that in the learning phase. However, different from the learning phase, the challenging phase fosters students’ master level of Chinese character learning. This intention is realized by a set of game levels, in which the student needs to take correct character cards in the limited time in these game levels. By doing so, students have more chances to practice what they have learned in the previous phase.

Figure 2. Three phases of the activity for the pet dragon system

References
An Investigation of Personality Trait on Asynchronous Computer-Mediated Communication Supporting Speaking Performance

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Abstract: The study was designed to offer an extended thread of speaking practice and performance with regard to in-class instruction and after-class exercise in EFL learning environment. To allow students to outspread speaking practice in class, an implementation of asynchronous computer-mediated communication in terms of audioblog was utilized to manage the after-class speaking practice and performance. In the meanwhile, individual difference has been seen as one of the most affected factors to shape learning, such as feature of personality. Thus, the study intended to understand the impact of personality trait would react on audioblog use for speaking performance in English, and the product of the presentation of speaking performance on audioblog. Two research questions were managed as R1: how does personality trait influence students’ speaking performance on audioblogs? R2: how do students with different personality trait manage the speaking performance on audioblogs? The participants were three hundred and twenty one male high school students. They were taking an English speaking class for a semester and recruited in the study. After each thematic speaking class, they were instructed to accomplish one thematic speaking performance and post it on their audioblogs accordingly. A mixed method of quantitative and qualitative was analyzed to collect the responses from the students with different personality trait. A few of affected matters from students, as well as the overall presentation of speaking performance on audioblog were gathered for data analysis. The findings of the study showed students with different personality trait affected distinctly on confidence and willingness in English after engaging with audioblog for speaking performance. Those who were inclined to be introverted showed the potential to accomplish more speaking performance than those who were more extroverted. In addition, the implementation of speaking performance on audioblog seemed to significantly influence students’ willingness in English after a long-period engagement, particularly to the introverted ones. On the other hand, the overall presentation of students’ performances on audioblogs revealed an astounding achievement that not only for the recording style but also the presentation format, and either extroverted or introverted students were apt to favor some presentation formats by the trait of personality.

Keywords: English as a foreign Language (EFL), personality trait, audioblog, speaking performance

1. Introduction

Language skills in term of listening, speaking, reading, and writing were distinguished from general language learning, which to provide an emphasis on specific language skill improvement. However, Sun and Yang (2013) indicated that speaking skill has been seen to have a desperate need of practice in the second language learning. Especially for English as foreign language (EFL) students who lacked of an authentic environment speak in English in daily life (Chiu, Liou, & Chen, 2007; Pong, 2010). As a result, a number of emotional and affected reactions might occur from students’ behaviors. For instance, students were deficient in confidence to speak and an influence on their willingness in English. Besides, the individual difference played as an important factor to power English language learning differently. For example, the personality trait was one of the individual differences, but scant of studies have been viewed to apply this feature in language learning context. To this end, a consideration
of not only how to inspire student to be positively affected and be willing to speak more English also how individual difference would impact the language learning with regard to English speaking performance need a well investigation. The study attempted to demonstrate an alternative English speaking instruction design with content and context to fulfill the above-mentioned consideration. In the meanwhile, a facilitation of computer-mediated communication (CMC) was implemented within the study for efficient teaching and learning. Hegelheimer and Tower (2004) revealed the CMC tool has been widely accompanying with its benefits on assisting language learning, and can assist particularly on speaking performance (Alastuey, 2011; Sun, 2012; Yanguas, 2012). There were two modes of CMC tool, which were synchronous and asynchronous approaches, such as chat room or blog, referred to different functions to support various language learning needs. Thus, the study aimed to provide more opportunities for speaking practice in English for students regarding the proposed instructional design, and a highlight on the asynchronous CMC mode was utilized as a tool in the study for after-class English speaking performance. The research questions were addressed as shown. R1: How does personality trait influence students’ speaking performance on audioblogs? R2: How do students with different personality trait manage the speaking performance on audioblogs?

2. Literature review

2.1 Speaking practice in EFL environment

Alastuey (2011) showed that a lack of practice resulted in inefficient English language development. Regarding the EFL environment, speaking skill was seen to be the most challenged language ability for students due to the insufficient practice. So, several affected matters such as being anxious and being worried about not having confidence would easily block students’ speaking development in English. These emotional states often further directly and indirectly influence their willingness in English. Consequently, even if how well-designed speaking activities and exercises were delivered to the students, the instructor did not notice those affected aspects from students on English speaking; the speaking practice from the designed activities would not be affected at all.

2.2 Asynchronous CMC- audioblog

One of the effective CMC tools in terms of audioblog was confirmed to provide an asynchronous (delayed time) way to offer learners flexible time to manage communication. Huann and Thong (2006) showed the elements of an audioblog not only consisting of audio condition but also supplementary features, as like visual supports in terms of texts, illustrations, and animations. In addition, Hsu, Wang and Comac (2008) and Sun (2009) have disclosed an implementation of audioblog into an English language class to support speaking development. The results showed positive effects on students’ speaking improvement with regard to the engagement of the use of audioblog, and further influenced their motivation and strategy use.

Furthermore, the study attempted to apply the use of audioblog into an English speaking instruction to offer an alternative channel to students for speaking practice in English. In the meanwhile, Fareed (2010) indicated that an aspect on pedagogical setting was important while building an instructional design, which would affect its effectiveness regarding what engagement would be considered into the instruction. Therefore, the study aimed to utilize the audioblog as facilitation to support students’ speaking practice in English after class. The reason that not using the audioblog into the classroom instruction was because several concerns which went against the feature of audioblog and might further interrupt the nature of speaking practice in a classroom-based setting. Those concerns were an influence of class size while engaging audioblog-based activity in the classroom; a nonappearance of face-to-face interaction, which lacked of authentic communication; and a limited class time might not afford students to complete tasks on audioblogs. As a result, the use of audioblog in the study was considered as facilitation for the after-class activity, which provided a space to students to develop individual speaking performance concerning the extension of the classroom lesson. Moreover, the study was designed within one phase of a cycle of English speaking instruction, which the audioblog was taken as facilitation to assist after-class speaking practice in English for students. More precisely,
the use of audioblog served the students for speaking practice after school rather than a supplementary in the classroom.

2.3 Personality trait

Personality trait was one of the featured individual differences has been discussed in the language learning. Eysenck and Eysenck (1975) firstly exposed the dimension of personality trait in terms of extroversion and introversion. With the definition, an extroverted learner tended to be fond of engaging with outer world and depended on external information for learning. On the other hand, an introverted learner tended to be fond of the inner space, which would like to think before acting, and was more independent on learning. In other words, the former ones were likely to show their ideas without restrictions while the latter ones were likely to express themselves in a more conservative way. Several previous studies indicated the students with different personality trait showed distinct preferences and language learning performances correspondingly. MacIntyre and Charos (1996) pointed out the introverted learners might be deficiency of willingness in the target language while comparing to the extroverted ones. The result echoed the study of Ehrman (2008) to understand the extroverted learners might be more effective in the target language learning due to the fact that they were more energetic in language learning activities. However, a study from Ehrman and Shekhtman (2005) argued that regarding the characteristics of introversion, the introverted learners have had the latent ability to learn language successfully. Therefore, the consequence of how the personality trait would impact the target language learning was yet answered; especially to the influence of speaking practice and performance in the target language.

3. Methods

3.1 Participants

Three hundred and twenty one high school students in Taiwan were recruited in the study. They attended an English speaking class in order to obtain more speaking opportunities and confidence in English for a semester instruction. Apart from the required English subject class, they did not have other practices and class relevant to English subject at school. Furthermore, all of the students had elementary computer ability, and were familiar with accessing web pages, surf the Internet, and other web 2.0 facilitations, such as email and blog.

3.2 Instruments

Both quantitative and qualitative analyses were employed in the study. Concerning the quantitative analysis, Eysenck Personality Inventory (Eysenck & Eysenck, 1975) enclosed with fifty seven yes and no questions and answers. In order to distinguish students’ personality trait on introversion and extroversion, the study focused on examining the measurement of extroversion. By the examining outcomes, it classified students with extroverted leaning (n=164) and with introverted leaning (n=157). Moreover, a self-report survey (α=.92) was used to see how students’ English speaking performance would be affected by engaging with the audioblog facilitation. The survey was a five-point Likert scale (1= strongly disagree, 2= disagree, 3= neutrally, 4 = agree, 5 = strongly agree). On the other hand, the qualitative analysis was examined by the content and context from the students’ audioblogs, and Google Blogger was chose for students’ audioblog use. It aimed to provide alternative information to apprehend how was the relationship of the performance on their audioblogs and their personality trait.

3.3 Procedure

The English speaking class was keen to offer more various speaking opportunities in English and affected students’ speaking performance. Therefore, the study took place in the speaking class every other week at school. There were six thematic English speaking lessons were applied with in-class instruction and practice, and after-class speaking performance. Figure 1 demonstrates a four-phase
cycle of the lesson charted by *thematic oral practice, thematic oral composition, interpersonal appreciation,* and sharing *and reflection.* More specifically, the first and the last phases of thematic oral practice and sharing and reflection were taken in a classroom-based environment while the second and the third phases of thematic oral composition and interpersonal appreciation were for after-class performance. In the study, the audioblog was applied in the second phase for the after-class thematic oral composition, and allow students to have time to create and complete their individual speaking performance which was relevant to the in-class theme. After each thematic lesson in the classroom, some prompts were given to the students. Such as, a theme “A Dream Trip”, and the following prompts would guide as “what kind of trip would you like to take? When/where would you like to go? What would you like to do on the trip? Would you like to buy any souvenirs?” The purpose of the prompt was to give students some directions and to build the theme relevant ideas before having an individual speaking performance on their audioblogs, especially to those who have not had initial thoughts to construct their own speaking performance. Later, they had to upload their recordings on their audioblogs as an after-class speaking performance. In order to make sure all the students could accomplish a recording successfully on their audioblogs, the instructor gave a demonstration and showed a complete process of using online recording and embedding on the audioblog. Furthermore, there was no restriction of the length of a recording, and the format of recording is flexible, too. Similarly, the recording was highlighted its clearness and comprehension, which the grammatical error was not the focus in the study.

![Figure 1. The four-phase cycle of English speaking lesson.](image)

**4. Results and discussions**

Two research questions were answered regarding the study results. R1 referred to the influence of personality trait on students’ speaking performance on audioblogs, and R2 discussed the diverse speaking performances of students with different personality trait accordingly. First of all, the descriptive analysis showed that the average speaking performance uploaded on students’ audioblogs, which the introverts (mean= 4.14, S. D.= 1.94) and the extroverts (mean= 3.37, S. D.= 1.93). The result indicated that the introverted students have accomplished more speaking performances on their audioblogs than the extroverted ones, and might further lead to a potential outcome that the introverted
students could gain more advantages towards the use of audioblogs for the after-class activity on speaking practice and performance. Besides, an examination of \( t \)-test was to show an impact of the personality trait to students’ speaking performance on audioblogs.

Table 1 displays the students with extroverted and introverted tendency would affect separately after engaging with speaking task on audioblog for a semester. The results presented a significant difference on willingness in English (\( t = 2.60, p < .01 \)) between the extroverted and introverted students. However, there was no significant difference on the impact of confidence in English (\( t = 1.73, p > .05 \)) between the extroverted and introverted students. In other words, the implementation of recording exercise on audioblog seemed to make an influence to capably encourage students’ willingness in English after a long-period engagement although it was a pity to see there was no statistical effect on students’ confidence in English.

More specifically, Table 2 illustrates the mean score of confidence and willingness in English to identify whether the significant difference appeared between the extroverted and introverted students. Thus, with regard to the effect significantly acted on willingness in English between students with extroverted and introverted inclination, the result further uncovered that the introverted students (mean= 3.74, S. D.= .79) outperformed the extroverted ones (mean= 3.48, S. D.= 1.02). In sum, the introverted students were more likely to obtain profits from the exercise of English speaking practice and performance on their audioblogs for after-class exercise than the extroverted students. The benefits in terms of reinforcement on willingness in English greatly exhibited to the introverts. The finding was remarkably to previous studies that mentioned the introverts were more reticent than the extroverts, which exhibited a less willingness in the target language. However, with alternative channel facilitation, as the study engaged with audioblog for after-class speaking practice and performance, it offered the introverted students to have the target language speaking practice in a more comfortable zone. Ultimately, the audioblog facilitation for the after-class speaking exercise created a means to benefit more the introverted students on target language speaking development than the extroverted ones.

**Table 1: Impact of personality trait on confidence and willingness in English.**

<table>
<thead>
<tr>
<th></th>
<th>t-test for Equality of Means</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>( t )</td>
<td>df</td>
<td>Sig. (2-tailed)</td>
</tr>
<tr>
<td>Confidence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introvert</td>
<td>1.73</td>
<td>315</td>
<td>.09</td>
</tr>
<tr>
<td>Extrovert</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willingness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introvert</td>
<td>2.60</td>
<td>305</td>
<td>.01</td>
</tr>
<tr>
<td>Extrovert</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 2: The mean of confidence and willingness in English for introverts and extroverts.**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidence</td>
<td>Introvert</td>
<td>157</td>
<td>3.77</td>
</tr>
<tr>
<td></td>
<td>Extrovert</td>
<td>164</td>
<td>3.60</td>
</tr>
<tr>
<td>Willingness</td>
<td>Introvert</td>
<td>157</td>
<td>3.74</td>
</tr>
<tr>
<td></td>
<td>Extrovert</td>
<td>164</td>
<td>3.48</td>
</tr>
</tbody>
</table>

In addition, R2 was to see the overall presentation of speaking performance in English on audioblogs from both extroverted and introverted students. The speaking practice and performance on audioblog in terms of speaking recording exercise was founded with a theme which was a following-up of the in-class English speaking practice. Furthermore, a few theme-relevant prompts would list to allow students to extend, brainstorm, and construct ideas for speaking exercise on their audioblogs individually. As a result, students could feel free to manage the time to upload their speaking recording
exercise on audioblog before next class. The average duration of each recording was approximately between half a minute to two minutes. Due to the fact that there was no limitation of recording style, the role of students was various while producing the recordings. Regarding students’ recording performances, it was fascinating to discover some of the students not only simply played as a narrator but also acted as a double role for Q and A, a radio host, and even a video channel host. The creativity of recording style shaped how the students constructed the recording content and context. Likewise, with regard to the presentation format of the recording on audioblog, several examples of the recording on audioblog presented diverse appearances.

Figure 2 illustrates vivid examples of a few recording performances on students’ audioblogs. Not only to upload the audio recording, but also to supplement the oral recording content with (A) text note/ script, (B) drawing/ picture, and (C) text with picture. Additionally, a presentation of reflection as a journal (D) was captured. The use of audioblog offered individual student a space to maintain his speaking performance every other week. Initially, the purpose of the audioblog use was to give students an alternative opportunity for speaking practice after class. Therefore, the expected outcome of students’ performance was the audio recording solely. However, concerning the feature of audioblog which allowed diverse types of presentation, it was attention-grabbing to see other varied presentation formats of performance from students’ efforts. Not only with a combination or supplementary of text or script messages, images, but also a maintenance of journal reflection was illustrated from students’ performances. Moreover, a different inclination of the presentation format of performance was discovered through students with dissimilar personality trait. The extroverted students were found out more attempted to utilize complementary information and figures to enrich their audio performances (see examples A/ B/ C of figure 2) while the introverted students less endeavored to add supplementary within their audio performance. Yet, an introverted student was inclined to demonstrate a reflected performance on his audioblog (see example D of figure 2). By keeping a text memo within each audio recording, he tried different approaches to complete the performance, which in turn to reveal an inner interaction of carrying out the performing progress. In sum, students’ performances on audioblogs showed a surprising accomplishment which not only for the recording style but also the presentation format. Furthermore, either extroverted or introverted students were apt to favor some presentation format by the trait of personality.
5. Conclusion

The study conducted an EFL speaking instructional design in order to outspread speaking practice in English from the classroom-based environment to the after-class setting. With the extension of the in-class thematic speaking lesson and practice, students needed to accomplish a thematic relevant speaking performance on their own audioblogs during the after-class time. The form and structure of the speaking performance was yet restricted as long as it was related to the theme. Additionally, students could either refer to similar discussion or other aspects with regard to the theme to complete their own speaking performances on audioblogs afterwards. Therefore, an understanding of how the personality trait would affect students on the speaking practice and performance on audioblog, and a general presentation of speaking performance towards students with different personality trait. As a result, through extending the in-class thematic speaking instruction every other week, students were guided to complete one thematic speaking performance in English on their audioblogs after class. The findings of this study showed that students with different personality trait did influence distinctly on confidence and willingness in English after engaging with audioblog for speaking performance. More precisely, those who were inclined to be more introverted showed the potential to accomplish more recording exercises than those who were more extroverted. In other words, the implementation of speaking performance on audioblog seemed to impact on students’ willingness in English after a long-period engagement, particularly to the introverted students. However, the students’ confidence in English did not reveal any improvement regarding the study. Additionally, the overall students’ performances on audioblogs showed an astounding achievement that not only for the recording style but also the presentation format, and either extroverted or introverted students were apt to favor some presentation formats by the trait of personality. By the understanding can further examined qualitatively how the students with different personality trait would prefer the recording style and presentation format on audioblog for an implication on sharpening EFL speaking instruction.

Acknowledgments

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References


Comparison of Kit-Build and Scratch-Build Concept Mapping Methods on EFL Reading Comprehension

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Abstract: In generally the reading comprehension is a very difficult task for students in all the stages of study, especially when they are reading text in a foreign language, the EFL reading” (English as foreign language) is one of the most common research topics in the learning field. This study aimed to investigate the effect of teaching EFL reading comprehension to Japanese students through Kit-Build concept mapping (KB-mapping) method. In doing so, we have conducted an experiment to compare the student comprehension with KB-mapping and Scratch-Build Concept Mapping (SB-mapping) Methods. In doing so, a comprehension test and delayed comprehension test (two weeks after using) were used. By comparing the results of the Comprehension Test (CT) scores and the Delayed Comprehension Test scores (DCT) for the both conditions groups, we found that the using of KB-mapping had the same effects of SB-mapping in the understanding the text just after the using, but KB-mapping had better effects in the recalling and remembering the text after a while.

Keywords: Technology-Enhanced Learning, Kit-Build Concept Map System, Reading Comprehension, EFL.

1. Introduction

Reading comprehension is one of the important learning activities, and needs a special ability from the learners to reap its benefits (Alkhateeb & Hirashima 2013). Reading comprehension poses many challenges such as slow reading, insufficient vocabulary comprehension and bad recalling (Alkhateeb & Hirashima 2014). Researchers have always tried to support this learning activity, by proposing methods or strategies. The main goal is to boost the comprehension skills in the target subject area. When they are deployed in a language course, the main aims are to improve student reading comprehension skills and to contribute to the acquisition of the target language (Rayner & Seidenberg 2001).

In this research, we are trying to support this complex learning task by using our KB-mapping method (Sugihara & Hirashima 2012). We have been developing learning tools to help both students and teachers within the learning process. One of these tools is Kit-Build concept map (KB-map). We found it a very useful tool for learning the sciences for the students in mother languages (Sugihara & Hirashima 2012), and we found that this tool yield good results for teachers and students. It should be noted that KB-map is a special kind of concept map and the using of KB-map needs a lot of concentration to recognize the two concepts that can be connected by a relation.

To investigate the effects of using KB-mapping, we designed an experiment where we compared the Scratch Concept mapping method (SC-mapping) for reading comprehension with our KB-mapping method. As known the SC-mapping is a flexible method that may be tailored to fit various types of information, and different skill-levels. As students read an EFL text, SC-mapping helps them learn to pay attention to the essential information within the text.
1.1 EFL Reading Comprehension

‘Comprehension’ as a concept is defined as “the ability to understand something” in the Oxford Dictionary, the definition of Cambridge Dictionary is “the ability to understand completely and be familiar with a situation, facts, etc.”; For the purpose of this research, ‘reading comprehension’ will be defined as “a learner’s ability to understand completely and memorize the important information that is included in the text that he/she is reading”. The definition necessarily includes the level of understanding of a text/message. Such an understanding comes from the interaction between the written words and how they trigger knowledge outside the text/message (Sugihara & Hirashima 2012).

The reading comprehension in an EFL context is a special case of reading comprehension; it is highly complex, dynamic, multi-componential and multi-dimensional task in the learning process. We can explain it as multiple interactions between the reader background and knowledge in his Mother Language (ML) and in the Target Language (English). Broadly speaking, the reading comprehension of EFL is the same as the ML reading comprehension but it is slower and less successful than ML reading (Neil Anderson 1999). This can be explained in that the reading process is depending on many factors such as the level of reader’s language proficiency, type of text, text difficulty and task demands.

It is a difficult task for students at all stages of study, especially when they are reading texts in a foreign language. Therefore, EFL reading has attracted attention in the teaching and learning field. Many researches came up and proposed methods, techniques and strategies to help students reading abilities. These attempts yielded significant improvements in students’ comprehension just after using the proposed methods or the strategies. To mention a few of these methods, there are the Selective Underlining Strategy, Note-Taking Skills Reading (Piola & T.keellogg 2005), SQ3R (Survey, Question, Read, Recite, Review) (Huber & Jennifer A. 2004). The most new strategies that proposed to support the reading comprehension task are the Graphic Organizers (GOs) as a reading strategy used both in the teaching and learning of languages. As examples of GOs are Story Maps, matrix, Semantics Maps, Knowledge Maps and scratch concept map (Manoli & Papadopoulou 2012).

Several investigations of reading comprehension strategies have specifically addressed challenges related to reading expository text. Positive outcomes have been found for students who were taught strategies to help students identify main ideas.

1.2 Scratch concept mapping method

SC-mapping is one of the most newly strategies that used to support the reading comprehension learning task and it gives good effects on EFL student’s reading comprehension. SC-map is visual representations of knowledge which can be employed as a learning strategy by the learners to find the relationship between current knowledge and new information (Salehi & Khodabandehlou 2013). The researches confirmed that the EFL students whom had treatment concept mapping gained high scores in reading comprehension (Salehi & Khodabandehlou 2013). Also there are many studies of students learning English reading through the use of concept maps showed that the concept mapping training or the semantic mapping technique could improve the students’ reading comprehension because they could understand the text more easily through the concept map (Phantharakphong & Pothith 2014) (Chularut & DeBacker 2004).

Scratch concept mapping provides students with opportunities to become actively involved in their learning while linking knowledge to long term memory. Through the use of concept maps, students have opportunities to organize their thoughts in a concrete and/or graphic/visual format, while connecting concepts and linking prior knowledge to new knowledge. Related concepts become connected rather than fragmented. Concept maps also provide them with opportunities to think about their own thinking as they reflect on their conceptual understandings. The process of map drawing has a positive impact on student’s awareness of the reading process and they can manage to have more control over reading comprehension in English by visually representing what is conveyed in the texts they read (Salehi & Khodabandehlou 2013).

1.3 Purpose of this experiment:
We have been developing learning tools to help both students and teachers in the learning process. One of these tools is KB-map. This tool was used in many fields of learning and we found that this tool has good effects in the reading comprehension of EFL students (Alkhateeb & Hirashima 2013). And it has effects in the remembering and recalling of the comprehended text after a while (Alkhateeb & Hirashima 2013). Also we found it very useful for learning sciences to the students in their mother languages (Sugihara & Hirashima 2012) and some studies suggest that KB-mapping is promising tool to estimate learners' understanding in class-room by using the diagnosis and feedback with the KB-map (Yoshida & Hirashima 2013), (-Funaoi& Hirashima 2012)). It also has good effects for the teachers and students.

Recently there are many researches proposed the scratch concept mapping method as a very effective method to support the EFL student’s reading comprehension task, and they found that SC-mapping method is good for comprehend the text and for recalling.

In this research, we are trying to use KB-mapping method to support the reading comprehension of EFL students again by comparing it with the SC-mapping method to confirm the effects of KB-mapping and SC-mapping in the comprehension and recalling of the English text.

2. Kit-Build concept mapping Method

2.1 Overview of Kit-Build Concept Map

KB-map is “a framework to realize automatic diagnosis of concept maps built by learners and to give feedback to their errors in the maps” (Sugihara & Hirashima 2012). KB-map is a special kind of concept map. The creation of concept map consists of two steps: the extraction of the concepts and the relations from the text and the selection of the responsible relation that connects two concepts together. In KB-mapping, the supervisor makes the first step by creating the goal map from text and after that he can generate the kit from the goal map by dividing the goal map to concepts and relations, providing learners with this kit. After that, learners are tasked to build the concept map (called learner’s map) by using the concepts and the relations that provided in the kit.

2.2 KB-map System

We have already developed a system based on the KB-map, explained in the previous section. This system is called as “KBmap System”. It is a web application with two client systems: “Cmap Editor” and “KBmap Analyzer”, and a server system: “KBmap DB”. Cmap Editor provides an environment for the teacher, or the supervisor, to make a goal map kit, and for learners to make a learner’s map. This system has been implemented by Java (version 1.6). KBmap Analyzer has functions to gather learner maps online, generate a group map and diagnose the maps. This system has been implemented by Flash and it supports Flash Player version 10. KBmap DB has a function to store and share maps. This system was developed by Ruby (version 1.8.7) on Rails (version 1.2.3) and MySQL (version 5.1.30) (Sugihara & Hirashima 2012).

The new version of Cmap editor has the functions to add concepts and relations to the learner’s map so we can use it as computerized SC-map editor in addition to the original use to create KB-map from the provided kit, and this version use the Point & Click functionality so the students can use it very simply to create the student’s SC-map. Figure 1 shows a part of the Cmap editor with the functional options.

Figure 1. Part of the Cmap editor.

3. Experiment Methodology
Our research investigates the effects of using KB mapping method as a supportive tool for the reading comprehension tasks by comparing them with the effects of using SC-mapping method from two points of view:
1. In the short-term view: we are measuring the understanding of the participants just after using our method, and comparing it with the understanding of other participants who use SC-mapping method with the same conditions.
2. In the long-term view: we are measuring the recalled information of the participants two weeks after using our method, and comparing it with another participants’ information who use SC-mapping method with the same conditions.
In this chapter we introduce three points of our experiment: the participants, the outline procedure of whole experiment and the detailed procedure of one session.

3.1 The Participants

The participants of our experiment are 11 Japanese students. They are in 3rd year and studying in the information engineering faculty. Their scores in TOEIC exam ranged from 390 to 730, so they had different reading abilities of English texts. We prepared an aptitude test to check their abilities in the reading comprehension. By using the information of their TOEIC records, the TOIC reading scores and the aptitude test scores, we grouped them into two groups A (***) is the average TOEIC score) and B (***) , which are almost commensurate with the reading ability.
We have done our experiment in 6 sessions and the two groups changed the conditions alternately. Every participant underwent three times the experimental conditions and three times with control conditions.

3.2 Procedure of the whole experiment

We planned to complete this experiment in six sessions of reading comprehension tasks for six different English texts. Firstly we introduced to the participants the strategy of this experiment, the procedure of every session and KB-map system. For the others session we started with the delayed comprehension test of the previous session. After that they did the current session, finally we did questionnaire at the end of the last session of the experiment. During this experiment every group did it with the experimental conditions for three times and with control conditions three times too. We tried to keep the balance between the different texts of this experiment.

3.3 Procedure of the first session:

In the experimental use, we are comparing the effects of using KB-mapping method and the effects of SC-mapping strategy in the reading comprehension process. We are measuring these effects over two stages: just after the using and after a while. We have designed the learning activity in this experiment in a limited period of time to avoid the effects of other supporting strategies. The process of one session, as shown in Figure 1, consisted of four steps:
In the first 10 minutes, both conditions groups were requested to comprehend the whole text by skimming it translating the difficult words in the text using a dictionary. Then, in the next 10 minutes the experimental conditions group was required to build the learner’s KB-map of the text by using KB-editor and in the same time the control conditions group was required to build the learner’s SC-map of the text by using KB-editor. After that both groups answered the comprehension test within five minutes. Finally, after two weeks both groups answered the delayed comprehension test.

<table>
<thead>
<tr>
<th>time</th>
<th>Experimental conditions</th>
<th>Control conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 min</td>
<td>Reading the materials (using dictionary is allowed)</td>
<td></td>
</tr>
<tr>
<td>20 min</td>
<td>Making the KB-map by using KB-editor</td>
<td>Making the SC-map by using KB-editor</td>
</tr>
<tr>
<td>5 min</td>
<td>Comprehension test (CT)</td>
<td></td>
</tr>
<tr>
<td>5 min</td>
<td>Delayed Comprehension test (DCT) (2 weeks after)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. The procedure of one session.
4. Experimental use

This experiment was done in 6 sessions with two groups of participants (A, B). Both of them had almost the same reading ability. For each group they use the KB-mapping method for 3 sessions and the SC-mapping method for 3 sessions too. In this chapter we introduced three points: the preparation of the used materials, examples of the real materials used in one session of this experiment.

4.1 Materials Preparation

Participants in this experiment were students in 3rd year at the faculty of information engineering, so they were interested in the topics of information engineering. Firstly we selected a text from Wikipedia in the information engineering field and checked it for the grammatical and semantically error. After that we created the corresponding KB-map (Goal map) that covered the main concepts and relations of the text. We prepared the comprehension test. And we checked all of the material again to be sure that materials did not contain any error. Finally we checked if the answers of questions of comprehension test were covered by the KB-map to marking the questions that were not covered.

4.2 Example of experimental material

In this section, we introduce one example of the materials that was used in the third session of our experiment. Figure 3 shows a part of the text that was used as the original text which learners tried to comprehend it. The participants requested to read and comprehend this text within 10 minutes and they had the ability to use online dictionary to translate the complex and unknown words to help them in understanding the whole text.

A language is typed if the specification of every operation defines types of data to which the operation is applicable, with the implication that it is not applicable to other types. In most programming languages, dividing a number by a string has no meaning. Most modern programming languages will therefore reject any program attempting to perform such an operation. In some languages, the meaningless operation will be detected when the program is compiled ("static" type checking), and rejected by the compiler, while in others, it will be detected when the program is run ("dynamic" type checking), resulting in a runtime exception.”

Figure 3. Sample of the used text in the third session.

After that, the experimental conditions group tried to build learner’s KB-map, within 20 minutes, by using the kit that was provided by the system which generated it from the corresponding goal map. Figure 4 shows the goal map of the text that was prepared by the supervisor. It contains most of the information of the original text; this goal map is divided by the system to generate the kit that is shown in Figure 5. Figure 6 shows one example of the learner’s KB-map.

Figure 4. The Goal map of third session.
At the same time, the control conditions group tried to build learner’s SC-map within 10 minutes too. The SC-map contains the important information of the text. Figure 7 shows one example of the learner’s SC-map of the same text.

After that all the participants did the same comprehension test within 5 minutes which is a set of multi-choices questions. All of these questions are asking about information included in the original text, some of them are included in the goal map and some are not, and for the SC-mapping it is the same. Figure 8 shows a part of the comprehension test of this session.

By the end of this test they finished the experimental use of that day and 2 weeks after they did the comprehension test again as a delayed comprehension test.
5. Results:

We performed our experiment with 11 students in 6 sessions. In three sessions we had 5 participants as experimental conditions group and 6 as control conditions group and in the others we had 6 participants as experimental conditions group and 5 as control conditions group. The participants were exchanging the conditions every session. So we had 33 scores as experimental conditions and 33 scores as control conditions, by analyzing these results we found that the using of KB-mapping method has the same effectiveness of the SC-mapping method for the comprehending of the text just after using the methods (comprehension test), but the KB-mapping method is more effective for recalling the comprehended information from the text after a while (Delayed comprehension test). The detailed results are presented in this section and we are presenting the results of the questionnaire that we did it in the last session.

5.1 Comparing KB-map Conditions group Scores and SC-map Conditions group Scores

By comparing the results of the Comprehension Test (CT) scores and the Delayed Comprehension Test (DCT) for the both conditions groups, we found that, for the Experimental Conditions Group (EC), the average difference between the DCT and the CT is -7.76 and for the Control Conditions group (CC), the average difference between the DCT and the CT is -17.23. We can notice that the differences of the EC group are better than the differences of the CC group for all the sessions of the experiment. And for more confirmation of these results we did more detailed analysis of the delayed CT and the CT scores of the two conditions group. Tables 1,2 shows the results of the T-Test for our results.

For the comprehension test:

By comparing the comprehension test scores of the both conditions groups we found that the total average score of the experimental conditions group is slightly better than the control conditions group average score. For every session we found the same results. Figure 9 shows the average score for every session. For more confirmation of this result we used the statistical test student’s TTest. By using the this test we found that there is not a real difference between the CT scores of the two conditions groups but as we see in table 1($P(TTest)=0.191 > 0.05$) that the average score of the EC group is slightly better than the average score of the CC group.

| Table 1: the comprehension Test average score. |
|-----------------|-----------------|-----------------|
| CT. Scores      | Experimental conditions group | Control Conditions group |
| Mean            | 85.313           | 80.323           |
| SD              | 11.986           | 16.941           |
| $P(TTest)$      | 0.1910           |

| Table 2: the delayed comprehension Test average score. |
|-----------------|-----------------|-----------------|
| DCT. Scores     | Experimental conditions group | Control Conditions group |
| Mean            | 79.063           | 66.1293          |
| SD              | 12.083           | 20.269           |
| $P(TTest)$      | 0.004            |
For the Delayed Comprehension test:
By comparing the Delayed comprehension test scores of the both conditions groups we found that the total average score of the experimental conditions group is better than the control conditions group average score. For every session we found the same results. Figure 10 shows the average score for every session. For more confirmation of this result we used the statistical test student’s TTest. By using the this test we found that there is a significant difference between the DCT scores of the two conditions groups but as we see in table 2(\(P(TTest)=0.0040 > 0.01\)) that the average score of the EC group is better than the average score of the CC group.

5.2 The questionnaire results:

After we finished the last session, the participant answered the questionnaire to evaluate the learning method of using KB-mapping and compared it with the SC-mapping method. Table 3 shows the results of this questionnaire.

Questions (1-6, 9&10) are 5 multiple-choices questions that measure the participant’s agreement with the mentioned point by the question. The choices used are (A. Strongly agree, B. Agree, C. Natural, D. Disagree and E. Strongly Disagree), and the questions (7&8) are 3 choices questions that compare between the two learning methods. The choices used are (A. KB-mapping, B. Same, C. SC-mapping). To normalize the results of this questionnaire, we tried to summarize all the results of our questionnaire and converted them to arithmetical form that means (1 Strongly Agree, 0.5 Agree, 0 Natural, -0.5 Disagree, and -1 Strongly Disagree). At the same time, it means (1 KB-mapping, 0 same and -1 SC-mapping). As a summarization of the questionnaire evaluation, 0 means the normal, the positive means agreement and the negative means disagree and the value shows the strength of the agreement or the disagreement.

In questions (1&4&7)(2&5)(3&6), participants thought that the KB-mapping method was as useful to understand English text as the SC-mapping. They also said that it was useful to answer the comprehension test just after the learning activity. But they thought that KB-mapping method was more useful to answer the delayed comprehension test two weeks after. Also in questions (8, 9) they thought that the KB-mapping method is easier to carry out, and they like to use KB-mapping method in reading comprehension task but they needed more time to do it.
Table 3: Evaluation of the proposed methods for EFL comprehension.

<table>
<thead>
<tr>
<th>N</th>
<th>Explanation</th>
<th>Average Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you think that SB-mapping was useful to understand English text?</td>
<td>0.4</td>
</tr>
<tr>
<td>2</td>
<td>Do you think that SB-mapping was useful to answer the test after reading?</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>Do you think that SB-mapping is useful to answer test two week later?</td>
<td>-0.05</td>
</tr>
<tr>
<td>4</td>
<td>Do you think that KB-mapping was useful to understand English text?</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>Do you think that KB-mapping was useful to answer the test after reading?</td>
<td>0.55</td>
</tr>
<tr>
<td>6</td>
<td>Do you think that KB-mapping is useful to answer test two week later?</td>
<td>0.1</td>
</tr>
<tr>
<td>7</td>
<td>Which method is more useful to understand English text?</td>
<td>0.6</td>
</tr>
<tr>
<td>8</td>
<td>Which method is more difficult to carry out?</td>
<td>-0.6</td>
</tr>
<tr>
<td>9</td>
<td>Do you like to use KB-mapping to understand English text?</td>
<td>0.2</td>
</tr>
<tr>
<td>10</td>
<td>Do you like to use SB-mapping to understand English text?</td>
<td>0.05</td>
</tr>
</tbody>
</table>

In general, we can say that the participants thought that the using of KB-mapping is similar to the SC-mapping for comprehension test but it was more useful to recalling the information after a while and it was easier to carry out. They liked to use it in reading comprehension task.

5.3 Considerations

The results of this experiment show that the using of KB-mapping method has almost the same efficiency as the using of SC-mapping method for comprehending the English text just after the using (the comprehension test), so we can say that the provided kit by the system has no advantage for the EC group to understanding the text in comparing with the SC-mapping method. But the KB-mapping method has better efficiency for recalling after a while (the delayed comprehension test). We can explain these results as the Using the KB-mapping required concentration in reading the text and the need to read with attention to distinguish the two concepts that could be related and to find the corresponding relation that can connect them together. At the same time, this process required the learner to understand the information in the text deeply and required them to comprehend the text in whole. But for the SC-mapping, the learner can parse the text sentence by sentence to distinguish the important concepts in the sentence and the corresponding relation that connects them in the same time.

6. Conclusion and future work:

In this paper, we describe the effects of using KB-Mapping method as a supportive tool for the reading comprehension of English texts as EFL reading. Overall, from this experiment we can conclude that the using of KB-map as learning supportive tool for reading comprehension is as good as SC-mapping in the short term, but it so better for the long term. Our next step goal is to generalize the results for larger groups, the research should be extended its time and the study should have been involved more participants at different levels. We are looking to study the effects of using KB-mapping method in the learner’s reading comprehension skills and developing more attractive environment to support this special kind of learning activity for enhancing text learning. Even given its limitations, this study has provided many ideas for ways to modify teaching practices. It seems that KB-mapping can help to stimulate and challenge students to look deeper into their reading. The scope of this study was only limited to reading comprehension. It is suggested that in future research the scope should be expanded in terms of other three important skills; writing, speaking and listening. By making the scope wider, the researchers can get a clear view of the utilization of KB-mapping in all aspects.
Acknowledgements

We would like to thank all the people who participate and support us in our experiment.

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Evaluating Augmented Reality for Situated Vocabulary Learning


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Abstract: Augmented reality (AR) is an emerging technology for communicating learning contents. Several AR systems are designed for learning. However, studies that have investigated instructional strategies for applying AR are few. This investigation requires the implementation of prototypes that use state-of-the-art technology and sound learning theory.

In this work, we implemented two prototypes for learning Filipino and German words by first developing a handheld AR platform. These prototypes demonstrate situated vocabulary learning. Using our AR system, students can learn words related to their current environment. We assessed the quality of these prototypes by conducting usability evaluations. For the theoretical grounding, we leveraged on multimedia learning theory to design the content.

Through our handheld AR platform, we evaluated situated vocabulary learning by comparing our prototypes to a flash cards application. In the first evaluation, students scored significantly lower when using AR in an immediate post-test. However, this difference disappeared after taking into account the variability in usability scores via analysis of covariance. Taking account usability is fairer when comparing an emerging technology to traditional technology. Test scores were also not significantly different in a delayed post-test. In the second evaluation, although the post-test score and answering time of students did not differ, our results showed that they feel more satisfied and can keep their attention better when using AR. For the first time, we demonstrated situated vocabulary learning by using AR. Moreover, our preliminary study confirms the intuition that students can achieve the same score using AR, but with benefits such as ease in maintaining attention and increased satisfaction.

Keywords: augmented reality, mobile learning, situated cognition, vocabulary learning

1. Introduction

Augmented reality (AR) is an emerging technology in the field of computers in education (Wu et al., 2013). We provide a useful summary of AR prototypes applied to learning in our review (Santos et al., 2014). Researchers do not usually take advantage of the most important feature of augmented reality: showing the explicit relationship of the virtual content to objects found in the real world. As such, we implemented and evaluated this display interaction for situated vocabulary learning (Figure 1).

Figure 1. Situated Vocabulary Learning. Student (left) is learning the word “asinan,” the Filipino word for adding salt, on a dish inside a kitchen-like environment. Our interface (middle) integrates sprite animations (right) to explicitly illustrate the virtual action on a real object found in the environment.
In situated vocabulary learning, the physical environment is the context of the vocabulary. In this paper, we did a preliminary comparison of our approach (Figure 2) against a flash cards application which doesn’t contextualize the vocabulary to the environment. For the first time, we evaluated usability, learning, and motivation in AR-based situated vocabulary learning.

Figure 2. Nouns are displayed as labels, whereas verbs are shown as animations on real objects.

2. Related Works

People are familiar with AR because of the many AR browsers used to locate interesting places in the world (Grubert et al., 2011). People use AR browsers to see virtual labels and symbols integrated with a live video feed of the real environment. Thus, understanding location-related information, such as names of buildings, distances of restaurants, arrows for navigation, and so on, becomes easier. In our AR application, instead of displaying names and direction, our system displays the objects of nouns and illustrates the action of verbs.

Several AR systems have been developed for educational settings (Santos et al., 2014). One important work is Construct3D (Kaufmann et al., 2000; Kaufmann, 2002), which uses AR to teach students mathematics and geometry concepts. AR is suitable because students can interact naturally with three-dimensional shapes without the use of a mouse and keyboard. While wearing a head-mounted display, students can move around virtual shapes and perform operations on them. Moreover, the students see the same shape, thereby allowing them to work together on the target virtual object. Although Construct3D and other works take advantage of embodied cognition and collaborative learning, previous prototypes do not use the main feature of AR. AR, where “3-D virtual objects are integrated into a 3-D real environment in real time” (Azuma, 1997), displays the relationship of the virtual object to the real environment. In the present paper, we teach vocabulary by displaying the relationship between virtual objects and the real environment.

We can apply handheld AR to show the relationship of the educational content to the real environment. Handheld AR has gained attention in the field of educational technology because of its benefits such as ubiquitous learning (Dede, 2011), situated cognition (Specht et al. 2011), and collaboration (Li et al., 2011).Billinghurst and Duenser (2012) argue that handheld AR technology is mature for this application. AR software can already run on mobile phones equipped with fast processors, big display screens, data connection, built-in camera, and other sensors. Billinghurst and Duenser (2012) call for more interdisciplinary research to ground AR applications in learning theories. For our experiments, we designed the content of our AR prototype by applying the principles of multimedia learning theory (Mayer, 2009) and its related research.

2.1 Vocabulary Learning Systems Applying Various Contexts

People learn new words in meaningful contexts. Words are interpreted as a part of a passage of text. As such, Chen et al. (2013) proposed hypertext annotations for supporting quick definitions when reading electronic text. To support vocabulary learning, many other interfaces leverage on constructing various other contexts such as word games (Lin et al., 2008), virtual environments (Pala et al., 2011), collaboration (Joseph et al., 2005), and interaction with robots (Wu et al., 2008).

A natural context for learning vocabulary would be the physical environment. As such, Edge et al. (2011) and Dearman & Truong (2012) propose to present words that are related to the student’s environment. Their systems involve the use of handheld devices and GPS positioning to detect the
student’s current environment and then present words that are related to that environment. In both systems, the students browse the words on the device screen. We extended these works by using AR to display content onto the physical environment. In our AR system, the vocabularies are either animations or labels on real objects as shown in Figure 2.

2.2 Systems for Situated Vocabulary Learning

Liu’s (2009) HELLO system demonstrated how handheld devices can be designed to promote significantly better learning outcomes. The HELLO system uses the campus network to deliver content for an English language learning system. It can detect the location of the user through QR codes spread around the school. At each location, students practice conversations with a virtual tutor on the device. In the user testing phase involving 64 students, Liu reported that students who used their system scored higher compared with those who used printed materials and audio recordings. This effect is attributed to practicing English in situations that could really happen in specific locations.

Beaudin et al. (2007) employed a different strategy to teach Spanish. For their research, they built a smart home learning environment that can detect user movements and intentions by using various sensors. Equipped with a mobile device, the smart home can identify who the user is and present relevant information. For example, they implemented a feature wherein voice-overs of Spanish words or phrases are triggered when users touch specific objects. This interaction makes an explicit connection between the Spanish content and the objects found in the learner’s environment, thereby promoting situated cognition. Both the works of Liu and Beaudin et al. take advantage of near-transfer, that is, applying knowledge learned in a particular situation to another situation that is almost similar in context (Dunleavy & Dede, 2014). Combining ideas from these prototypes, we implemented a handheld AR platform (Section 3) to present contextual texts, images, and sounds in the real-world environment.

2.3 Multimedia Learning Applied to Vocabulary Learning

In multimedia learning theory, multimedia refers to pictures and words (both written and spoken). This theory assumes three things, namely, dual-channels, limited capacity, and active processing (Mayer, 2009). First, multimedia learning takes advantage of the two separate channels for perceiving visual and auditory information. Second, it recognizes that individuals have a limited capacity of information that they can attend to. Lastly, learning only takes place if the learner actively processes incoming information by connecting them to prior knowledge.

Given that individuals have a limited capacity of information that they can attend to, Lin and Yu (2012) investigated the cognitive load induced by different types of media presentations on a mobile phone. In their study with 32 eight graders, they investigated the use of four multimedia modes, namely, text, text with audio, text with picture, and text with audio and picture. They discovered that the multimedia mode does not have a significant effect on vocabulary gain and retention. However, the learners rated the combined text-audio-picture as the mode that induced the least cognitive load.

Lin and Wu (2013) investigated the use of these four multimedia modes in a succeeding study with 423 junior high school students. They did not find any significant differences in vocabulary recognition nor in any interaction between multimedia mode and learning style preferences of the student. However, the participants who used text with audio and picture performed best in listening tests followed by the text with sound group. This result confirmed the intuition that audio annotations contribute to the construction of phonological knowledge of words and then applying this knowledge in listening to sentences. More importantly, they reported that the learning effects of the audio were maintained for two weeks with minimal attrition. Based on these works, we implemented features in our AR platform (Figure 3) to allow users to access text, audio, and pictures during the learning scenario.

In a separate study with 121 senior high school students, Lin and Hsiao (2011) studied the effects of the use of still images against simple animations in vocabulary learning. Their results showed that the animation group performed significantly better in learning Chinese and English vocabularies compared with the image group. They recommended the use of animations to illustrate dynamic words and processes. Thus, to facilitate better understanding of vocabulary in our handheld AR platform, we included a feature where sprite sheet animations can be used. We found this feature to be a simple solution to illustrate verbs in our learning scenario.
3. Implementation

We created two AR applications for learning Filipino and German words in a real environment. We achieved this objective by first creating a handheld AR platform that can display any situated multimedia — images, animations, sound, and text displayed on a real environment (Figure 3). We then filled the platform with content for the situated vocabulary learning of Filipino and German words.

3.1 Handheld Augmented Reality Platform

Figure 3 shows the package diagram of our platform and the sample interface enabled by our platform. The main part of the platform is the Controller, which has access to learning contents, sensor (camera), and user inputs. The Controller receives the marker ID and camera view matrix from the Tracker and uses these information to specify the behavior of the on-screen display. The Tracker was built using ARToolkit, and the Renderer was built on OpenGL ES 2.04.

![Figure 3. Package Diagram of Our Handheld Augmented Reality Platform (left); Sample Interface for Situated Vocabulary Learning (right)](image)

We used the ARToolkit (Kato & Billinghurst, 1999) to measure the camera pose with respect to the target object. Markers in the video feed were located using the ARToolkit, which also outputs the marker’s ID and the matrix representing the current view of the camera. The image was transformed to the correct view using the matrix, and then it was rendered accordingly using OpenGL ES 2.04.

The platform runs entirely on iPad tablets. For our experiments, we used the iPad 2 (dual-core A5, 512MB DDR2 RAM, 32GB, 601 g, 9.7 in display, 1024-by-768 at 132 ppi), and the iPad mini (64-bit A7, 512MB DDR2 RAM, 16GB, 331 g, 7.9 in display, 1024-by-768 at 163 ppi). The platform works with fiducial markers (Figure 3) to determine the target object and the viewing angle of the tablet’s back camera. We used the back camera set to 640x480 pixels at 30 fps to sense the marker and to provide a video feed. After identifying the marker, the platform loads the corresponding audio, text, and image. Audio and text can be accessed using buttons (LISTEN, TRANSLATE, DESCRIBE). The images can either be still images or sprite sheet animations (Figure 3; Figure 1). The images are transformed depending on the camera view and are inserted in the video feed to suggest 3-D registration, that is, to give an impression that the graphics co-exist with the real objects.

3.2 Situated Vocabulary Learning Content

We used the platform to construct two situated vocabulary learning systems: one for 30 Filipino words and the other for 10 German words. We based the design of the content from previous works (Lin & Hsiao, 2011; Lin & Yu, 2012; Lin & Wu, 2013) by using a combination of text, audio, images, and animations as content. The text data are the vocabulary, its translation in English, and the description of the scene (only for the Filipino version). The audio data is the proper pronunciation of the vocabulary as spoken by a native speaker. The image data are text labels, images, or labels, as shown in Figure 2.
4. Experiments

We explored the strengths of our AR applications for situated vocabulary learning over its non-situated counterpart (Figure 4) in two preliminary experiments. Through these experiments, we aim to evaluate the use of AR for viewing vocabulary content that is situated in the real environment. We compared the AR applications to a non-situated version which is a tablet application that mimics flash card interaction. Our comparison does not employ any kind of special instructional design such as game mechanics and collaborative learning. As summarized in Table 1, users simply point the tablet PC to objects found in their environment when using our AR application. On the other hand, the flash cards application allows the user to flip through contents by pressing either next or previous.

![Figure 4. Non-situated version of the AR applications.](image)

Table 1. Comparison of Two Interfaces for Vocabulary Learning

<table>
<thead>
<tr>
<th></th>
<th>Situated (AR app)</th>
<th>Non-situated (Flash cards app)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction</td>
<td>Users find an object with a marker. They then point the tablet PC to the marker to reveal the content.</td>
<td>Users press “next” or “previous” to switch between contents.</td>
</tr>
<tr>
<td>Inherent Feature</td>
<td>Users can see the markers in their environment even when they are not studying.</td>
<td>Users can quickly go through all the material because they are arranged in a series.</td>
</tr>
<tr>
<td>Visual Display</td>
<td>Images and animations are displayed on the real environment.</td>
<td>Static illustrations are shown on a white background.</td>
</tr>
<tr>
<td>Place and Time</td>
<td>Users can only use it inside their laboratory at any time.</td>
<td></td>
</tr>
</tbody>
</table>

We considered inherent features of the interaction as part of the treatment. Thus, interventions were not done to control it. For example, one advantage of an AR learning system is that the students see the objects in their surroundings even when they are not studying. We imagine this feature to trigger unintended rehearsal of the vocabulary, thereby improving learning. This unintended rehearsal is part of AR learning; thus, we did not control this aspect. We did not forbid the students in the situated treatment from visiting the study place when they are not studying.

Another inherent feature is that students tend to cover all the vocabularies several times in one study session when flash cards are used. The flash cards are serially arranged, and students try to go through all the content two to three times in one sitting. Even if this is the case, interventions were not made because it is an inherent feature of the use of flash cards. Moreover, advising the students who use the AR application to view all the content several times will interrupt their natural learning style.

For our experiments, we controlled both location and time constraints. All of our students were only allowed to use the applications inside their respective laboratories. However, the applications are available to them at any time they want to study on that day. Given these features, we had seven hypotheses which we tested for significance in the 0.05 level via student’s t-test and analysis of covariance (ANCOVA). The hypotheses are as follows:

H1. Students will perform better in an immediate post-test with non-situated vocabulary learning.
H2. Students will perform better in a delayed post-test with situated vocabulary learning.
H3. Students will rate situated vocabulary learning as a more motivating instructional material.
H4. Students will maintain their attention better with situated vocabulary learning.
H5. Students will find the contents of situated vocabulary learning as more relevant to them.
H6. Students will feel more confident with non-situated vocabulary learning.
H7. Students will feel more satisfied with situated vocabulary learning.

4.1 Experiment 1: Learning Thirty Filipino Words in Five Days

We adapted a between-groups approach with 31 participants (26 male, 5 female, aged 23–42, information science graduate students) to test our application for studying Filipino words. The first languages of the participants are Japanese (13), Chinese (5), Portuguese (3), German, English, Turkish, Bosnian, Indonesian, Finnish, Arabic, Spanish, Nepali, and Wolof. In our experiments, we divided the people into the treatment groups with consideration to the distribution balance of their first languages.

Eighteen participants were recruited from one laboratory. We set up our system inside their laboratory (Figure 5) so that they can learn words related to their refreshment area. All of them have experienced using an AR application before. As such, AR is not a novel technology for them.

Twelve participants from three laboratories were asked to use the non-situated version. Similar to the situated group, the non-situated group have used AR before and they are familiar with other novel interfaces. We distributed tablet computers to them with the flash cards application installed.

Figure 5. Refreshment area with markers (left), Learner using situated vocabulary learning (middle), Learner using non- situated vocabulary learning (right)

The participants used the assigned application for a recommended duration of 10–15 min per day for five days. The situated version was used inside a refreshment area with a maximum of four people using the application at the same time (Figure 5). On the other hand, the learners used the non-situated version wherever they went inside their laboratory office.

In this experiment, we evaluated the participants’ learning outcomes and the usability of the application. On the fifth day, the participants answered the System Usability Scale (SUS) to measure the perceived usability of the applications (Lewis & Sauro, 2009). They then immediately took a post-test. After 12–14 days, they took a delayed post-test. The immediate post-test (27 items) and delayed post-test (24 items) consists of questions on recognizing the word in a multiple choice question, recalling the translation of the word, and guessing which word fits in different contexts.

4.2 User Testing 2: Learning German Words

We adapted a within-subjects design with 14 participants (8 male, 6 female, aged 17–20, science majors) to test the application for learning 20 German words (10 situated and 10 non-situated). Each participant used the situated and non-situated versions for a maximum of 8 min. Seven used the situated version first, whereas the other seven used the non-situated version first to balance any effect of the ordering of the treatment. For the situated version, the learners viewed the content on a small area around a laboratory technician’s desk. The markers are placed near each other in a small area to minimize the time spent transferring from one object to another. This is important because we wanted to observe the study time of the students. For the non-situated version, they used the application while sitting inside the same room.

The students are then asked to answer 10 multiple choice questions that test their skill to recognize a word. Aside from logging the answer, we also logged the time it took for the learner to
answer the question. After taking the quiz, the participants also answered a subset of the Instructional Materials Motivation Questionnaire or IMMS. We picked 30 questions that are applicable to our system out of the 36 questions listed in the work of Huang et al. (2006). IMMS models the extent of motivation one gets from an instructional material by using the ARCS model (Attention, Relevance, Confidence, and Satisfaction). This model has been applied to AR instructional materials by Di Serio et al. (2013).

5. Results and Discussion

Our experiments involved a small sample size, thus the results should be interpreted with caution. These should be replicated with a bigger sample size. Nevertheless, these results can guide future design of AR applications and experiments in situated vocabulary learning with AR. In our experiments, no significant differences were observed in learning outcomes between situated and non-situated vocabulary learning. However, students report better attention and satisfaction in using our system. We found evidences that support hypotheses H4 and H7 but not H1–3 and H5–6.

5.1 Experiment 1: No significant difference in usability and learnability

We computed the SUS score and its factors from the participant responses in Experiment 1. The results in Table 2 show that the AR application has an SUS score of 74%, which is close to its flash cards application counterpart with 80%. According to Sauro (2011), both interfaces are above average (68%); thus, they are both good interfaces. Moreover, the results in Table 3 show that our participants did not have difficulty in learning these new interfaces.

We did not find a significant difference between the two interfaces. As such, using these interfaces to compare situated and non-situated vocabulary learning is reasonable. We achieved a good usability score because we applied previous research in multimedia learning. Furthermore, our current interface features are minimal, and the study task is simple.

Table 2. System Usability Scale Scores for Situated and Non-Situated Vocabulary Learning

<table>
<thead>
<tr>
<th>Application</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>T value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUS Score</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR</td>
<td>18</td>
<td>74%</td>
<td>12%</td>
<td>1.64</td>
</tr>
<tr>
<td>Flash cards</td>
<td>13</td>
<td>80%</td>
<td>6%</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Factors of the System Usability Scale Scores

<table>
<thead>
<tr>
<th>Factor</th>
<th>Application</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>T value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usability</td>
<td>AR</td>
<td>18</td>
<td>70%</td>
<td>14%</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>Flash cards</td>
<td>13</td>
<td>76%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Learnability</td>
<td>AR</td>
<td>18</td>
<td>90%</td>
<td>13%</td>
<td>1.53</td>
</tr>
<tr>
<td></td>
<td>Flash cards</td>
<td>13</td>
<td>96%</td>
<td>5%</td>
<td></td>
</tr>
</tbody>
</table>

5.2 Experiment 1: Significantly higher score with non-situated for immediate post-test but not for the delayed post-test

Table 4 is a summary of the results of the immediate and delayed post-tests in Experiment 1. In the immediate post-test, the non-situated group scored significantly higher with a moderate effect (d = 0.75) than the situated group. The breakdown in Table 5 shows that the situated group scored lower than the non-situated group in all types of questions. This result is indicative of an overall inferior mastery of content rather than a weakness in a particular question type.

In most practical cases, people do not apply their learning immediately after studying. Rather, they would use their knowledge after a few days, either for a test or to apply it to a new lesson. As such, the delayed post-test is a more important point of comparison for learning than the immediate post-test. After 12–14 days, the significant difference in learning disappeared (Table 4).
Table 4. Total Scores in Immediate and Delayed Post-tests

<table>
<thead>
<tr>
<th>Post-test</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>T value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>Situated</td>
<td>18</td>
<td>71%</td>
<td>20%</td>
<td>2.14*</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>86%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Delayed</td>
<td>Situated</td>
<td>12</td>
<td>68%</td>
<td>23%</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>70%</td>
<td>18%</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05

Table 5. Immediate Post-test Scores for Each Question Type

<table>
<thead>
<tr>
<th>Type</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>T value</th>
</tr>
</thead>
<tbody>
<tr>
<td>With illustrations</td>
<td>situated</td>
<td>18</td>
<td>87%</td>
<td>12%</td>
<td>0.99</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>92%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Recognizing Filipino with choices</td>
<td>situated</td>
<td>18</td>
<td>80%</td>
<td>15%</td>
<td>2.54**</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>94%</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Recognizing Filipino without choices</td>
<td>situated</td>
<td>18</td>
<td>64%</td>
<td>30%</td>
<td>1.95*</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>83%</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>Translating from English to Filipino</td>
<td>situated</td>
<td>18</td>
<td>55%</td>
<td>31%</td>
<td>2.54**</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>81%</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td>Transfer of word usage with choices</td>
<td>situated</td>
<td>18</td>
<td>75%</td>
<td>19%</td>
<td>2.40*</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>91%</td>
<td>16%</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01

5.3 Experiment 1: No Significant Differences in Immediate Post-test Scores After Considering Usability as Covariant in ANCOVA

If both AR and flash card applications have the same SUS score, then we could do the fairest comparison possible. However, despite our best efforts, a small difference of six SUS points was still observed between the two groups. We conducted ANCOVA to take into account this difference in quality. We assume that the quality of the implementation of the interface affects the students’ scores.

ANCOVA was conducted because the difference in SUS score is not significant. We also checked the homogeneity of variance using the Levene’s test. The results of the Levene’s test showed that no significant differences (p > 0.05) were observed. Thus, our data have homogenous variances. The ANCOVA results (Table 6) show that no significant differences were observed in the test scores of situated and non-situated group for both immediate and delayed post-tests. We guess that if we can improve our AR application to the same level as the flash card application, then students can perform equally well with a novel interface.

Table 6. Analysis of Covariance of Post-Test Scores with System Usability Scale Score as Covariant

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Adjusted Mean</th>
<th>F value</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate</td>
<td>situated</td>
<td>18</td>
<td>71%</td>
<td>20%</td>
<td>72%</td>
<td>3.02</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>86%</td>
<td>20%</td>
<td>85%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delayed</td>
<td>situated</td>
<td>12</td>
<td>68%</td>
<td>20%</td>
<td>69%</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>non-situated</td>
<td>13</td>
<td>70%</td>
<td>16%</td>
<td>69%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.4 Experiment 2: No significant difference in Post-test and Motivation, but significantly better Attention and Satisfaction with Situated Vocabulary Learning

No significant differences were observed in the immediate post-test between situated (m = 94%, sd = 8%) and non-situated (m = 95%, sd = 8%) vocabulary learning. On the average, the non-situated group answered our multiple questions faster (m = 2.28 s, sd = 0.92 s) than the situated group (m = 2.60 s, sd = 1.03 s) for each question. However, this difference was not significant.
Experiment 2 focuses on evaluating motivation by using the ARCS model. Although two interfaces can arrive at the same learning result, performance in tests should not be the only measure of success in creating interfaces. User experience is another important consideration. As such, we also evaluated the interfaces in terms of its ability to motivate students to learn.

Overall, no significant difference was observed in the IMMS rating of situated and non-situated vocabulary learning (Table 7). However, looking at the factors of the IMMS (Table 8), significant differences were observed in the attention and satisfaction factors. The students report that the AR application catches and holds their attention more than the flash cards. Moreover, they report higher satisfaction with their learning experience. The learners were slightly more confident to use flash cards probably because it is a more familiar interface. The learners rated AR to be higher in relevance by five points, which is attributed to the implicit connection between learning contents and real environment. However, no statistical significance was observed for the relevance and confidence factors.

| Table 7. Instructional Material Motivation Survey Scores for Situated and Non-situated Scenarios |
|-----------------------------------------------|-----|-----------|-----------|--------|
| Treatment          | N  | Mean %    | Standard Deviation % | T value |
| Motivation Score   |    |           |                       |        |
| situated           | 14 | 76%       | 12%                   | 1.34   |
| non-situated       | 14 | 71%       | 11%                   |        |

| Table 8. Factors of the Instructional Material Motivation Survey Scores |
|-----------------------------------------------|-----|-----------|-----------|--------|
| Factor            | Treatment | N  | Mean %    | Standard Deviation % | T value |
| Attention         | situated  | 14 | 75%       | 14%           | 1.84*   |
|                   | non-situated | 14 | 65%       | 14%           |         |
| Relevance         | situated  | 14 | 74%       | 14%           | 0.97    |
|                   | non-situated | 14 | 69%       | 13%           |         |
| Confidence        | situated  | 14 | 80%       | 12%           | 0.74    |
|                   | non-situated | 14 | 83%       | 8%            |         |
| Satisfaction      | situated  | 14 | 77%       | 16%           | 1.71*   |
|                   | non-situated | 14 | 66%       | 18%           |         |

*p < 0.05

6. Conclusion

We are the first to use AR for explicitly displaying the relationship between vocabulary learning contents and real world environment for situated vocabulary learning. This preliminary study supports our intuition that AR can enable the same knowledge acquisition with added benefits of better attention and satisfaction. We did not employ special instructional strategies in our experiments such as game mechanics or collaboration between students. As such, the differences in the learning experience are attributed to the inherent advantages or disadvantages of the interfaces: augmented reality and flash cards representing situated and non-situated vocabulary learning, respectively.

Our system can be improved by applying other learning theories and instructional strategies that are not possible for traditional interfaces. Currently, we applied multimedia learning theory because AR is essentially a presentation medium. In the future, we can apply insights on location-based games and collaborative learning to create better augmented reality learning experiences.

References


System Design for Academic Listening of Second Language Based on Strategy Object Mashups Approach

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Abstract: Most foreign students studying abroad lack of effective academic listening ability which is considered to be essential for them to achieve their academic successes. Moreover, as listening comprehension ability is also considered to be the most difficult to improve in contrast with the other three (Reading, Speaking and Writing), the purpose of this research is to support the training of academic listening skills for students pursuing academic success in a foreign educational institute. We have identified several learning strategies proved to be effective for cultivating academic listening skills from related work and built up the respective strategy models. Based on the established strategy models, we are now in the process of designing and developing various strategy objects (function units), so as the mashups environment where these objects can be assembled and operated. Unlike previous learning systems that provided identical functions to the learners, this research is expected to provide the learners with self-adjustable learning environment by putting together various strategy objects provided. We also attach semantic meanings (listening strategies and tactics) to each object to improve the metacognitive awareness of strategy application of the learners, for the effectiveness in listening practice as proved in past studies. Furthermore, a feedback agent is to be implemented to recommend proper strategy objects to the learners based on their learning situations. As a result, the learners are expected to be able to: practice their listening under an adaptive learning environment, strengthen their metacognitive awareness of the strategy application, and adjust their learning environment constantly with the support of the feedback agent or through peer reviews.

Keywords: Academic Second Language, Listening Strategy, Strategy Objects, Strategy Object Mashups

1. Introduction

Among the other language skills (Reading, Writing and Speaking), academic listening poses serious challenges to F/SL (Foreign, Second Language) learners. Even for students with high level of proficiency and being comfortable with everyday listening and conversation, listening tasks encountered in academia still seem formidable (Mason, 1995). Academic listening is complex, multi-faceted process that places enormous skill demands on the listener (Richards, 1983). Since researches have shown that effective academic listening comprehension skills are essential for the students to achieve academic success (Benson, 1994; Dunkel, 1991; Vandergriffit, 2004), studies focusing on this subject are actively conducted worldwide. Among those, listening strategy is an important subject, which is playing an important part in improving listening skills (Goh, 1998). Evidence from various studies revealed that F/SL learners, regardless of skilled or unskilled, were all applying some listening strategies, consciously or unconsciously (Goh, 2002). Some of those researches have shown that the difference lies in what they are using and the way of using them (Smidt and Hegelheimer, 2004). Learners with higher listening ability tend to choose listening strategies more adaptive to their learning and put the chosen strategies into practice more effectively than the unskilled ones (Goh, 1998). Moreover, since what learners know about their learning can directly influence the process and even the outcome of it (Palmer and Goetz, 1988), it has been proved more than once the
importance of improving learners’ metacognitive awareness of listening strategy through various experiments of related researches (Goh, 1998, 2008; Holden, 2004; Bozorgian and Pillay, 2013). Goh (2008) stressed in her findings that learners need to be aware of how their listening comprehension is affected by their choice of listening strategies to develop flexibility in the use of listening strategies as well as find suitable ways for systematic practice, ultimately be able to obtain listening skills. In order to address this issue, we proposed a strategy object mashups approach (Li and Hasegawa, 2014) which enables learners to practice their listening ability under the adaptive supporting functions while making them aware of their strategy applications and how would they affect their learning. Moreover, by attaching semantic meanings (listening strategies) to the different functions used by each individual, we also expect the perceivable comparisons of different functions used among the learners to take place, which leads to the possibility for the communication on learning techniques and methods. Therefore, unlike previous researches that provide fixed identical functions to the learners, we entitle the learners with the flexibility of building up their distinctive learning environment by putting together function units provided, along with the self-adjustment supported by peer-reviews and system recommendation. In this paper, we discuss this approach in further details and introduce the system design. The following sections are arranged like this: we firstly talk about the concept of listening strategy and the difficulties existing among F/SL learners trying to apply proper listening strategies into their practices, and secondly identify the requirements and purposes of this research, and then we introduce our research method called strategy object mashups approach along with the system design, and finally provide an overall view of the system Graphic User Interface (GUI).

2. Issue Addressed

2.1 Listening Strategy & Comprehension Tactics

In cognitive psychology, the term ‘strategy’ is linked to the conceptual framework of human learning and memory and refers to mental steps or operations carried out to accomplish cognitive tasks (Clark and Lisa, 2009). As a result, listening strategies are mental mechanisms carried out by second language learners to achieve reasonable comprehension when processing information contained in a large input of utterance, for they have to work under the constraints of an overloaded working memory, and a lack of linguistic, sociolinguistic and content knowledge (Call, 1985; Farch and Kasper, 1986; Goh, 2000). O’Mally and Charmot (1985) categorized listening strategy into three classifications: Metacognitive strategy, Cognitive strategy and Social strategy. Generally speaking, cognitive strategies are fundamental operations taken by the learners directly on their learning subject to obtain knowledge. Metacognitive strategies are concerned with how to learn or with learning to learn, involving with planning, monitoring and self-evaluation combined with the learning process. Social strategies are social behaviors learners conduct when communicating with others, and examples include asking skilled ones for advises, to compare notes and etc. The concept of comprehension tactics (which is referred as tactics in this paper) was brought up by Goh (1998). She defined tactics as individual mental techniques through which a general strategy is operationalized. Goh also identified that the tactics used for the same strategies vary from learner to learner, and skilled learners demonstrated better on strategy choices and the combination of appropriate tactics (Goh, 1998). In this research, we refer tactics as the learning procedures or processes when constructing strategy models, and also as the semantic meanings attached directly to the strategy object mashups of each learner, which will be explained in later sections. For the comprehension tactics are processions of understandable learning behaviors to operationalize listening strategies, it is possible to identify and organize comprehension tactics proved to be effective in academic listening, and then correspond these tactics to the according listening strategies under the classifications of the meta-cognitive, cognitive and social define by O’Mally (1989).

2.2 Difficulties in Applying Listening Strategies in Academia:

Although researchers in the field of linguistics have repeatedly proven the effectiveness of consciously adopting adaptive strategies in listening practice through various methodologies, there are several
difficulties for foreign students to successfully utilize proper listening strategies in most of the cases. Firstly, it is difficult to consciously put listening strategies into operation. Indeed, there are efforts having been put into teaching the techniques to insinuate the application of listening strategies (Hossein, 2013), and the result of which was positive. However, in academic life in which foreign students often are pressed by hard schedules and mostly failed to attend such classes, self-directed learning is the main approach for practicing. As a result, they tend to resort to their inefficient accustomed way of practicing without being aware of what strategies they are using and how these strategies affect their learning. Secondly, it is difficult to flexibly adopt adaptive listening strategies. Factors including personal traits, motivation level and cognitive style may influence the strategy choice (Oxford and Nyikos, 1989). Because of their lacking of strategy knowledge and guidance from experts in strategy application, it is difficult to come up with an adaptive combination of listening strategies which suits the learners’ characteristics and learning goals. Thirdly, it is difficult to put social strategies into practice. As for self-directed learning is the mainstream among foreign students to build up the necessary skills of the targeted language, it is considered inconvenient for them to get involved actively in communication or cooperation with like-minded people to ask help, exchange ideas and acquire advices. This leads to the missing of learning opportunity and sharing of knowledge.

2.3 Related work and Research Requirements:

Back in the late 80’s, and early 90’s, with the fast development of information technologies and the prevailing use of computer, CALL was breaking ground in the new technology frontier and began to draw attention. Up to now, numerous CALL systems have been developed to meet different requirements. Some of them are working as an additional supplement to the actual teaching courses known as blended learning (Wiki), which are not designed for self-directed learning and proved performing better in the combination of instructors’ involvement (Li and Wang, 2012). Furthermore, for CALLs appropriated for self-directed learning, there are still some limitations. First of all, they did not pay attention on how to improve learners’ metacognitive awareness of learning strategies. They provided the learners with sets of pre-designed supporting functions without explaining the reasons why those functions were introduced and how would they affect the learning. Secondly, the supporting functions provided to the learners were not adaptive to everyone, since the learners were offered with the identical learning environment. Despite of the fact that there are researches on the adaptive learning system actively conducted throughout the years, most of them focused on the adaptation from the viewpoint of learning materials, not the learning functions (Yang, Hwang, Chiang and Yang, 2013; Wang and Mendori, 2013; Fisser and Strijker, 2014;). In those researches, learners were not in the position of choosing or adjusting system functions to meet their individual learning needs. Thirdly, they are not providing enough support to take social strategies into account, which causes the lack of communication among the learners themselves. There have been studies such as the one on enabling limited sharing and peer-reviews on learning outcomes (Ogata and Yano, 2004), the learning techniques of each learner and the strategy application are not the focuses to be represented in a universally recognizable way.

Having considered these limitations existing in current CALL systems, and in order to address the difficulties encountered by foreign students described in section 2.2, we come up with three corresponding requirements, which if satisfied, are assumed to be able to improve the current learning situation for self-directed listening practice. These requirements are:

1. A learning environment where not only effective supporting functions are provided but also the strategic meaning of each function are provided in order to improve the awareness of strategy application.

2. The flexibility of adjusting the supporting functions in the learning environment by the learners themselves according to their own characteristics and learning needs.

3. A more effective communicative platform where not only the sharing of established knowledge can take place, but also the learning techniques and strategy applications of each learner can be perceived and communicated, while probably leading to the proper adjustments to their learning environment.

Aiming to effectively address these requirements, this research intends to design and develop a self-directed and community-based learning environment with the main purposes of: making the learners aware of strategy application, helping them build up adaptive learning environments, and
enabling them to communicate on not only leaning resources and knowledge but also on learning strategies and techniques. We expect the learners to learn and improve their learning skills through: the strengthened metacognitive awareness of their strategy application; the process of building up their adaptive learning environments which will be constantly adjusted by themselves from peer-reviews and system recommendation; and the awareness of the relationships between their learning activities and the according listening strategies.

3. Approach

3.1 Concept of Strategy Object Mashups Approach:

Figure 1 describes the concept of this approach. Strategy models are learning procedures or processes commonly adopted to execute listening strategies. Based on the established strategy models systematized from listening strategies that have been proved to be effective for cultivating academic listening skills, the respective function units, which are referred as strategy objects in this paper, can be developed. The learners are expected to choose their interested strategy objects to compose their personal distinctive learning environment that we refer as strategy object mashups in this paper. In this approach, there is also a social strategy platform implemented to support the communication not only on learning knowledge but also on strategy object mashups, which can be perceived as peer reviews on learning techniques. As the learners are building and adjusting their learning environment, a feedback agent collects and analyzes all strategy object mashups created by everyone to recommend the learners with more appropriate strategy objects for the proper functional adjustment according to their features and learning goals.

![Figure 1. The Concept of Strategy Object Mashups Approach.](image)

3.2 Ontology-driven Multi-layer Map Model:

Considering the three requirements described in section 2.3, the relationships among strategies, tactics and the learning environment need to be created in order to ensure every strategy object be traced to its according tactics and strategies. For this reason, we have designed the system model in an ontological manner. A multi-layer model is a core of this learning environment and intended to perform as a GUI for self-directed S/FL learners for self-directed and community-based listening practice. Figure 2 shows the model, which possesses of four layers. The object layer is where the system presents all the strategy objects for the learners to choose and assemble. Also, the detailed description of each object will also be provided to the learners to help them make reasonable choices. The learners choose their wanted objects and the system assembles the selected ones into strategy object mashups on the upper layer where
basically, the learners conduct their listening practice while making references to the mashups of others if necessary. The tactic layer is where to display the tactics being adopted based on the learners’ object mashups, by putting together the tactics traced from the selected objects. And accordingly, the listening strategy operationalized by the tactics can be found on the strategy layer. The upper two layers are meant to attach semantic meanings to object mashups of each learner, with the purpose of improving their metacognitive awareness of what listening strategies and tactics are being used and how they affect their learning. For example, if we assumed that one of the learners in Figure 3 picked the objects of “display comments of other people, “display background knowledge” and “input keywords”, the chosen three objects are working together as object mashups to support the learning activity. By tracing the comprehension tactics related with the chosen objects, the tactic “inference from related background knowledge and comments of others and input keywords” is generated and so does the corresponding strategies which are inference and cooperation in this example. Basically, with this system, the learners are expected to be capable of: (A). Creating their personal mashups; (B). Referring to others’ object mashups to make adjustment to their own; (C). Adjusting their personal mashups by the recommendation from feedback agent. As mentioned before, we have designed this model using ontological manner to connect these four layers, which will be explained in details later. The connections between layers are to be stored and analyzed by the feedback agent for the proper recommendation of the object mashups for the learner. Therefore, by using the proposed system, the learners would be able to assemble their personal object mashups by putting together proper objects, to refer to others’ object mashups for possible adjustment of their own, and to take into account of the system’s recommendation of new object mashups that could be more effective.

Figure 2. Multi-layer Model.

Figure 3. A Concrete Example of Multi-layer Model.
3.3 System Framework:

Figure 4 describes the framework of this system. At the beginning, a learner selects the listening materials, which in this research will be in the form of the lecture videos. And then, he/she will select the needed strategy objects to construct a distinctive personal listening environment. The next step would be practicing his/her listening and along the way, making adjustments to the learning environment. The learner can compare the mashups having been adopted by the other learners who have listened the current listening materials. Through the comparison of each other’s application of object mashups, along with the attached tactics and listening strategies, the learner can adjust his/her own mashups and strengthen the metacognitive awareness of the strategy application of his/her own and the others. The strategy objects, comprehension tactics and listening strategies are managed by the system in an ontological manner which will be discussed in detail in the following section, to trace back the according tactics and strategies for the learner based on his/her choices of the strategy objects. Meanwhile, a feedback agent, as another aspect of this research, will be designed and developed to recommend proper object mashups to learners through the analysis of the mashups of the current learners and the ones who has listened the learning material, combined with the current learner’s performance. In this way, we hope that the learners will be able to adjust constantly their learning environment through system recommendation and peer reviews and eventually, build up their listening skills in the process. As to the mechanism of this feedback agent, please refer to our published paper (Li and Hasegawa, 2014).

3.4 The Ontological Relationship among Strategy Model, Strategy Object & Strategy Object Mashups:

The ontological relationships between the listening strategy and the tactics are referred as the strategy models as shown in Figure 5. And then the strategy objects will be developed based on various established strategy models. In order to visualize each tactic into minimum-sized function units yet capable of being operated either alone or cooperatively, we take into account the actions learners usually take (See, Write and Listen) while doing listening practice, and then combine them into the strategy models. Because we intend to attach tactics and strategy to the object mashups composited by the learners, we relate the items of strategy, tactic, and strategy object and object mashups in an ontological manner as shown in Figure 5. The strategy models are expected not only to be able to represent the learning processes of different learners who uses diverse tactics for the execution of the same listening strategy, but also to be presented as the model of the intellectual activities with the applicable description for designing purpose. The following example better illustrates this ontological...
mechanism by introducing several strategy models we have established along with the according tactics and strategy objects.

Figure 5. The Ontological Manner among Strategy Model, Strategy Object and Mashups.

Figure 6 shows partially the ontological mechanism of how we systematize the listening strategies into strategy models and how the strategy objects are being derived. All the listening strategies are subclasses of the three major categories whose relationships have been determined by O’Mally (1989). The tactics are the ones organized from various related researches that have been proved to have the positive effect on academic listening. In this figure, there is a typical cognitive strategy called ‘take note’. Ordinarily, to operationalize this strategy, we suppose the learners can summarize the important keywords from the transcript of a learning material beforehand or, they might want to dictate the whole transcript while checking the subtitles to monitor their accuracy. Hence, we identified these two tactics, which, by taking account of the learning actions the learners commonly take, are divided into learning procedures. For the former tactic, the learners first action would be seeing the transcript followed by writing important keywords from it, leading to existence of the objects ‘show transcript’ and ‘write down keywords’. As to the latter tactic, with the same process, we firstly conclude that the learners need to listen the learning material and then dictate all the content along the way, checking the subtitles constantly to correct their errors and collect knowledge. As a result, the objects needed would be listening to a video (we plan to use videos as the learning materials), writing transcript and seeing the subtitles. In this way, we expect, the strategy mashups composited by the learners can bear semantic meaning of tactics and strategies by being traced back the objects consisted of.

Figure 6. An Example of the Ontological Mechanism.
4. The Concept GUI of the Proposed System:

In this section, we will introduce the image of the system GUI and how learners would apply it in their self-directed learning for listening practice. As the pilot system is still under construction, please be noted that the graphs used below contain partially Photoshop-edited items in order to best illustrate the gist of the learning environment.

We have grouped all the developed strategy objects according to the action learners usually take from listening practice on the left side, so the learners are assumed to be able to quickly decide on their choices for strategy objects as long as they are sure of what to see, what/how to listen and what to write. Meanwhile, considering the fact that academic listening mainly takes the form as lecture-taking, it is considered reasonable to divide the phases of this process into pre-listening, on-listening and post-listening. Therefore, on the right side of the screen, there are these three listening phases into which the learners can drag and drop the objects they think might be helpful as shown in Figure 7. As some of the objects are not to be allowed to use in certain phrases (For example, all the objects related with audio control apparently are not appropriate for pre-listening), and some objects only work effectively in combination with certain others, and examples of this include that the objects for inputting (writing keyword, etc.) are of no meaning without being used together with objects like (display related pictures/abstracts, etc.), we will design the rules and reminding cues into the ontological mechanism to regulate object selection aiming to achieve maximum effectiveness.

![Figure 7. The Process of Building Strategy Object Mashups.](image)

When the learners finish the process of building object mashups, they can begin their listening practice as shown in Figure 8. The training page is divided into two blocks. The right one is where the learners conduct their listening practice, which is consisted of multiple windows that respectively are the visualizations of the selected strategy objects. The learners can change the size of each window and drag and drop the selected ones into places they think fit. On the left side, the system presents the structures of object mashups of all the three phases in connection with the according tactics and strategies. The reasons for this GUI representation are, first of all, to help the learners improve their awareness of their strategy application by presenting the structure of the relationships between their object mashups and the according strategies and tactics; secondly, by navigating through objects across phrases, the learners will strengthen the connections between strategies and learning phases, which might lead to their proper operation of listening strategies and tactics in their real academic life.
5. Conclusions & Future Work:

This paper has designed the learning environment where the learners not only are able to construct adaptive supporting functions by putting together wanted strategy objects, but also to be aware of the corresponding comprehension tactics and listening strategies they are adopting and how are they affecting their learning with the purpose of improving their listening skills, through the ontological reasoning mechanism. Moreover, the learners are expected to learn through building up object mashups, which can be flexibly adjusted by the comparisons with that of others’ and the recommendation from the system feedback agent. We believe this research might open the possibility of providing an adaptive learning environment for diverse learners and a more recognizable format for reference and communication on learning skills and methods in a virtual place.

In the near future, we firstly will continue our design and development of the strategy objects based on the established strategy models, so as the mashups environment as web services using Microsoft ASP.NET MVC. After finishing the pilot system, an evaluation will be conducted in our institute using the video archive of lectures, which contains all the courses in our department. We will firstly to make sure whether the learning effectiveness can be improved through building up object mashups, and secondly whether the adjustment of mashups positively affected by peer comparisons and from the system recommendation.

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References


Cross Campus Peer Feedback on Writing using a Web 2.0 Resource: Initial Findings

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Abstract: With the ever increasing use of web 2.0 resources in support of English as an International Language (EIL) teaching, the increase in learner online collaborative/social learning necessitates research to enhance our understanding of this form of activity. This study therefore investigated a specific case of EIL learners providing peer feedback on the writing of other EIL learners through a Web 2.0 resource. Anonymous asynchronous nonreciprocal feedback was collected from students in three Taiwanese universities participating in a cross campus activity commenting on peer narrative compositions posted on the Storybird internet site. The aims were to ascertain what kinds of feedback were provided and whether it varied depending on the apparent proficiency of the person whose writing was being responded to. The writers were of two levels of proficiency (freshman and senior). Results from qualitative and quantitative analysis show a rich variety of kinds of response. In general the focus was on the content more than the form and included a considerable amount of genuinely communicative response to the message in the story being read. There were a number of differences in both the quantity and quality of the feedback given to each group of writers, which with the less proficient group often exhibited signs of politeness strategies such as starting with a positive comment to soften later negative comments, using more positive than negative comments, and establishment of an interpersonal tone with explicit use of first and second person pronouns. The findings suggest that this type of feedback is potentially valuable to complement conventional teacher feedback, and that the cutting edge technology of Web 2.0 can be valuably integrated into the formal curriculum for EIL learning.

Keywords: writing (composition), comment (feedback), EIL, peer evaluation, online learning

1. Introduction

The benefits of Web 2.0 for education, including foreign language learning, have been widely advocated (e.g. Luo, 2013; Wang and Vasquez, 2012). Although a good deal of empirical research is actively ongoing, there remain many specific backgrounds and levels of learner and many types of language task where we still have insufficient evidence to be able to say with confidence even what actually occurs, let alone how effective it is, when learners engage in language-related activity through this medium. The current study therefore aims to add to our knowledge by investigating one such specific case - the kinds of feedback provided by university level EIL non-majors in Taiwan to stories written by peers of more than one proficiency level.

There is a continuing history of studying feedback (aka response, review, evaluation, assessment) given to students about what they write. Traditionally this includes considering not only teacher feedback but also peer feedback and self-feedback, and latterly automated computer feedback, provided either during the writing process or after a final draft has been produced. Research begins with analyzing what kinds of feedback these different sources give, on various dimensions such as corrective versus non-corrective (Ferris, 2012) and many others (e.g. Ellis, 2009).

Most of this research has been on handwritten compositions where feedback is given on the hardcopy, often in a classroom setting. However, where the composition is produced and revised electronically, there is the opportunity for more and more writing, even in the context of classroom instructed learning, to be not just written but also delivered electronically and to receive feedback through the same medium, whether from a teacher or from peers (Ware and O'Dowd, 2008) or an online writing centre (Rosalia, 2010) or from other readers. Indeed increasingly compositions are more widely published or shared in some way online via blogs (Vurdien, 2011), wikis (Woo et al., 2013; Pifarre and Fisher, 2011), Moodle (Díez-Bedmar and Perez-Paredes, 2012) or websites designed for this purpose, such as iLap (Lu and Law, 2012) or Storybird, which is the subject of the current study. In this way compositions are liberated from the classroom environment and available for feedback from anyone

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who is licensed to access the site and chooses to read them at any time, including teachers, peers and complete strangers on the WWW, who may include native speakers of the target language (and collaborative rather than single-authored writing is also facilitated).

This sort of asynchronous computer mediated (CMC) feedback on writing has been relatively little studied and while we know of a few studies close to ours, none have precisely the same parameters. For example they involve peer feedback on email correspondence rather than compositions (Vinagre and Munoz, 2011), or on asynchronous discussion (Ware and O’Dowd, 2008), or they involve feedback from peers who are native speakers of the target language of the writers rather than other learners of it (Li, 2013), or from teachers of writing (Alvarez et al., 2011). Although these studies suggest something of the kind of feedback provided, they do not throw light on whether peers differentiate between writers of different levels. For our task and situation, the first requirement, as we perceive it, is to investigate simply what kind of feedback is given in this medium by genuine learner peers, and how far it resembles feedback found in other studies, including of non-internet published compositions, and whether peers are sensitive to different kinds of writers. From such a base one can then progress to other crucial issues such as the effectiveness of the feedback.

2. Research questions

2.1. What kinds of unprompted feedback in English do Taiwanese university students give in online response to English compositions by unknown non-English major peer learners?

2.2. Is their feedback different depending on the level of writing proficiency exhibited in the compositions?

3. Method

3.1. The context and participants

The study took place with cooperation of three Taiwanese universities. We gathered two sets of stories written by Taiwanese students and published in Storybird, each with feedback via Storybird from other Taiwanese students, all in English. All participants were native speakers of Chinese, of ages ranging between 18 and 25.

The story writers came from two non-English major groups which participated. Those taking the Children’s Literature Appreciation and Creation course (CLAC) were seniors so reasonably proficient in English. Those taking the Oral Training course (OT) were freshmen so of lower English proficiency.

The students giving feedback on the stories were other Taiwanese students of rather varied English proficiency levels. Some were from the same university as the writers, others from other universities.

3.2. Procedure

25 CLAC and 31 OT students each wrote a story individually online in Storybird as part of course requirements. No suggestions were made as to what topics to write about, or for what audience, except that if they could not think of an imaginative topic they should write introductions about themselves. In fact the OT story writers fell back on this option quite often, and generally wrote shorter stories than CLAC students. The teacher intention in getting them to do this was to practice their general English writing skills, in narrative genre. The students knew they were going to get feedback via Storybird from other Taiwanese students whom they did not know.

The pool of students giving feedback had access to Storybird to respond to whatever stories they wanted to from OT or CLAC writers. In fact they did not all respond to all stories, and indeed some only responded to CLAC stories, some only to OT stories. These students were asked to respond in their own time out of class. Participation was not obligatory and no incentives were offered. The respondents were not prompted as to which stories to respond to nor trained in how to respond, since we were interested in their spontaneous feedback, and they were not told that some stories were from students of different English proficiency from others.

3.3. Data Analysis
The feedback was downloaded and stored in Word files, where it was analysed by the researcher repeatedly, using the Comment function to record the analysis. First, 656 distinct chunks were identified which appeared to constitute distinct pieces of feedback information. Next, these chunks were each multiply coded in an initial coding for key aspects of the content of the feedback. For example the chunk *You have misspelled some words* was coded LANG SP NG U, capturing that it was a negative evaluation statement targeting an aspect of the language, the spelling (though not pointing to a specific item), with explicit reference to the writer. *I hope that you have a satisfied career in the*

<table>
<thead>
<tr>
<th>Feedback category</th>
<th>Group of writers responded to</th>
<th>CLAC</th>
<th>OT</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evaluative position with respect to (some aspect of) the story</strong></td>
<td>Description (Non-evaluation)</td>
<td>10.0</td>
<td>9.5</td>
<td>9.75</td>
</tr>
<tr>
<td></td>
<td>Positive Evaluation</td>
<td>27.5</td>
<td>32.6</td>
<td>30.05</td>
</tr>
<tr>
<td></td>
<td>Negative Evaluation</td>
<td>26.3</td>
<td>18.3</td>
<td>22.3</td>
</tr>
<tr>
<td><strong>Aspect of story targeted</strong></td>
<td>Language, including:</td>
<td>11.9</td>
<td>18.3</td>
<td>15.1</td>
</tr>
<tr>
<td></td>
<td>Grammer</td>
<td>4.7</td>
<td>5.8</td>
<td>5.25</td>
</tr>
<tr>
<td></td>
<td>Spelling</td>
<td>3.1</td>
<td>0.7</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>Vocabulary</td>
<td>1.6</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Fluency</td>
<td>0.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>Content, including:</td>
<td>56.3</td>
<td>52.3</td>
<td>54.3</td>
</tr>
<tr>
<td></td>
<td>Part of story only</td>
<td>4.1</td>
<td>4.8</td>
<td>4.45</td>
</tr>
<tr>
<td></td>
<td>Plot of story</td>
<td>11.9</td>
<td>2.0</td>
<td>6.95</td>
</tr>
<tr>
<td>Other aspects of the stories:</td>
<td>Genre</td>
<td>1.3</td>
<td>7.5</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Simplicity</td>
<td>4.1</td>
<td>2.4</td>
<td>3.25</td>
</tr>
<tr>
<td></td>
<td>Shortness</td>
<td>5.9</td>
<td>3.1</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td>Style</td>
<td>2.2</td>
<td>1.0</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>Specific item</td>
<td>3.4</td>
<td>1.7</td>
<td>2.55</td>
</tr>
<tr>
<td></td>
<td>Pictures</td>
<td>3.1</td>
<td>3.4</td>
<td>3.25</td>
</tr>
<tr>
<td><strong>Reported effect on feedback giver</strong></td>
<td>Affective</td>
<td>4.7</td>
<td>2.7</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
<td>6.9</td>
<td>7.8</td>
<td>7.35</td>
</tr>
<tr>
<td><strong>Non-declarative formulations used</strong></td>
<td>Suggestion</td>
<td>17.5</td>
<td>12.9</td>
<td>15.2</td>
</tr>
<tr>
<td></td>
<td>Comment</td>
<td>13.8</td>
<td>17.3</td>
<td>15.55</td>
</tr>
<tr>
<td></td>
<td>Hope</td>
<td>1.3</td>
<td>6.5</td>
<td>3.9</td>
</tr>
<tr>
<td></td>
<td>Thanks</td>
<td>1.3</td>
<td>2.7</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Greeting</td>
<td>0.0</td>
<td>1.7</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>Question</td>
<td>1.6</td>
<td>2.0</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Explicit reference to participants in communication</strong></td>
<td>Feedback giver (I)</td>
<td>26.6</td>
<td>29.2</td>
<td>27.9</td>
</tr>
<tr>
<td></td>
<td>Writer (you)</td>
<td>27.5</td>
<td>53.7</td>
<td>40.6</td>
</tr>
<tr>
<td></td>
<td>Audience in general</td>
<td>2.2</td>
<td>4.8</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Communicative response to writer’s message</strong></td>
<td>18.8</td>
<td>29.6</td>
<td>24.2</td>
<td></td>
</tr>
</tbody>
</table>
Future was coded HOPE I U CM, capturing that it is an expression of hope with genuinely communicative force, mentioning both the reviewer and the story writer explicitly. This coding was progressively refined as the data was gone over repeatedly.

Initially it was planned to use one of the feedback classifications from the literature, but it soon became apparent that those were unsuitable as they mostly dealt only with corrective feedback, which was a small minority of the feedback in this study. Hence we adopted a more ethnographic approach and developed from the data itself a set of codes which seemed to capture the main themes expressed. The resultant classification is wide-ranging over linguistic and non-linguistic areas (see the categories in Table 1). For quantitative reporting, since the amount of feedback was different for each of the two groups of stories, frequencies are presented standardized per 1000 words of feedback.

4. Results

A number of results stand out. First, the amount of feedback providing language correction, common in many studies of feedback on writing, is relatively small. As Table 1 shows, positive attitudes are expressed more often than negative ones (which are implied by correction), and instances of feedback on core areas of language such as grammar and vocabulary are far outnumbered by those on content and other matters. Furthermore, there was a considerable amount of communicative feedback, in the sense of response to the actual message conveyed by the writer rather than to the language or coherence of storyline etc.

Second, there are some clear effects of the two groups of story writers. Stories by more proficient CLAC writers received feedback from between 0 and 41 people (average 15.3 per story), and the amount of feedback was on average 517 words per story. By contrast the less proficient OT stories attracted feedback from between 0 and 11 people (average only 3 per story), and the average length of feedback was only 95 words per story. The number of words written by each person giving a response was only slightly less for OT stories, however: 32 on average versus 34 for CLAC. Hence the key difference is in how many people chose to respond to stories from the two sources rather than how much feedback each person who did respond wrote. We speculate that, left to their own choice, in contrast with most studies in the literature where they are required to respond, the respondents in our study opened some OT stories and thought them too simple or full of errors to be worth commenting on so closed them without responding. CLAC stories on the other hand attracted their interest more.

There are also clear differences in the type of feedback, based on our analysis of its content (Table 1). One notable difference is in the evaluation. There is slightly more evaluation overall of the CLAC stories, but what is more marked is the difference in polarity. While the amount of positive and negative evaluation of CLAC stories was more or less the same, OT stories received considerably more positive than negative evaluation. This is clearly not because the OT stories were actually better, but presumably reflects a wish to encourage what were detectably weaker students. What is not reflected by the table is that also in general in the feedback given by each person a positive point was mentioned first, before negative ones, with the same softening effect.

Another key area of difference is in the areas focused on. One might have expected considerably more attention to the language of the less proficient OT stories, and indeed language feedback is 50% greater than that given to the CLAC stories. However, it remains little compared with feedback on content and is largely given at a general level, with few specific items identified, and only slightly greater attention given to grammar. The greater feedback on genre could be due to the fact that many OT stories turned out to be self-presentations rather than stories as such. Furthermore, OT stories receive considerably more communicative response than CLAC ones, suggesting a wish by the feedback givers to demonstrate to OT writers that it was possible to engage with the message conveyed by their texts despite the deficiencies in the language used to convey it. Finally, OT response is characterized by far more explicit reference to the OT writer by the respondent than occurred for CLAC, so conveys to the writers reading the feedback a much greater feeling of personal attention.

By contrast CLAC writers attracted more negative evaluation than OT ones, though this is directed more towards aspects of the content, such as the story plot, than to the language. CLAC writers were also to some extent criticized for writing too briefly or simply, perhaps because the feedback givers recognized that their level of writing ability allowed them potentially to write at a higher level than some of them did.
5. Discussion and Conclusion

This is a small, exploratory study, but nevertheless highly suggestive. The focus on content rather than language form bears witness to the impact of the ‘content creation’ focus of Web 2.0 in general, while the incidence of fully communicative responses is consistent with its ‘social rapport’ aspect (McLoughlin and Lee, 2007). Most studies of feedback (whether on paper compositions or online text) are, explicitly or by implication, conducted in conditions where corrective feedback is required or expected, and hence we do not see this focus. Ware and O’Dowd (2008) however did include an ‘e-partner’ condition where respondents were left free, and report a similar finding to ours that when peers are not instructed to respond on matters of language form, they very often choose not to. There seems little doubt that the nature of the medium, along with the fact that participants were not in our study directed in what feedback to give, allowed or encouraged the participants to give feedback in a much richer and more humanistic way than the traditional narrow range of largely negative evaluative and language oriented feedback. The feedback often feels closer to a social exchange or conversation (Danis, 1987) than an educational response, and far from mimicking “teachers’ feedback, which was mostly teacher-centred, <and> made students passive and dependent on teachers,” (Lee, 2008: 144).

The following example of a complete piece of feedback to a CLAC story illustrates how the respondents were often able to combine feedback on content and language with elements of communicative response to the message: “You use simple words successfully to show us the great family's love!! It is very close to our daily lives because sometimes when there is a new member in our family, some parents would feel so happy that ignore their children without the intention. But actually parents love their all children very much from their deep heart! But maybe you can mention the new member's relationship with the boy later in the story. I think that it would become more complete!!"

The differences between responses to writers of different proficiency levels also show students’ ability to vary response according to the writer, where they choose to respond, which is a characteristic also of expert teacher response (Vandercook, 2012). Although language issues are predictably more targeted with less than with more proficient writers, there seems to be an attempt to encourage weaker writers by also emphasising positive aspects, targeting content more than language, and engaging in more communicative response with a strong interpersonal tone than with more proficient writers. In effect this is a form of what has been termed mitigation in the traditional feedback literature (Treglia, 2009).

In conclusion, there is much more work to do in this area. Interviews would be valuable to confirm some of the interpretations we have offered. The impact on the story writers needs to be investigated, such as how satisfied they were with the feedback, what they implemented as a result, and of course whether they benefited, e.g. in being encouraged to write more or in improvement of their writing products. Some traditional studies have suggested that in fact it is specific feedback on language points that is most expected and effective (e.g. Sweeney, 1999), hence it remains to be seen whether the rather different focus of unprompted Web 2.0 mediated feedback in fact also has learning benefit. The impact on the respondents can also be investigated. Their English was also far from perfect, but does it in any way improve through this sort of activity? Topics like this have been researched in the traditional feedback literature, but are as yet largely untouched in the online Web 2.0 medium for non-native speakers. The challenge for Web 2.0 at university level remains whether such EIL peer interaction provides a “means to link informal and recreational writing with formal and academic writing.” (Godwin-Jones, 2008:7).

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References


Development of Multimodal Tool to Support Pronunciation Training in Second Language Classroom – Case of Japanese*

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Abstract: Rapid technological advancement in computer and mobile technologies has resulted in inclusion of different multimodal tools for teaching and learning language. Most of these software and tools are designed to assist learning process of adults and mostly used for remote learning. But there are fewer studies that take into account the needs of such technology in children’s language classroom and suggest tool development according to children’s intellectual level. While most of the studies focus on English language learners, not many studies focus on acquisition of Japanese as a second language at elementary level. In this study we focused on finding out technological needs of the teachers to understand what kind of tool can actually fit language classroom and meet children’s need and intellectual level. From the analysis of user studies, we derived the key functions of the interface that are – lesson customization, personalization and feedback for integrating the tool in classroom. Based on those key components, a multimodal tool containing image and audio functions was developed on iOS platform. The interface was then evaluated by a group of users that received positive feedback. The full result of the evaluation will be reported later.

Keywords: second language acquisition, pronunciation training, multimodal application

1. Introduction

1.1 Research Topic

Emerging technological advancements in the field of information science and technology in the last couple of decades have given rise to remarkable change in the way people gather knowledge and information. Therefore, representation of learning contents have changed from simple text-based reading and writing to mixture of textual, audio and visual modes, which is often referred to as multimodality (Miller, 2007).

With the development of Computer Assisted Language Learning (CALL), researches on the implication of computer for teaching and learning foreign language have increased to a prominent level (Levy, 1997). But Fox (1993) argues that, “there is no generally accepted theory of Second Language Acquisition (SLA) to embrace with confidence”. Garton (1992) further suggests that, “One must look carefully at the specific attributes of this learning environment and then consider which model of SLA most closely matches the capabilities of hardware and software.” Therefore, prior to implementing CALL courseware for a particular language like Japanese, further understanding of learning context is necessary. According to Weber (1997), the number of people who spoke Japanese as second language was approximately 8 million in 1997. According to the survey of Japan Student Services Organization (JASSO), the number of foreign students studied in Japan was reported to be around 140 thousand in 2012, which includes both adult and children. Since the official language at Japanese educational institutions is Japanese, these students typically have to conduct their study in

* This work was carried out when the first author was a student of the University of Tsukuba.
Japanese. They also have to deal with all kind of information in Japanese in their daily life. Moreover, according to the report of Modern Language Association, there is a significant expansion in the number of Japanese learners in U.S. colleges and universities, where an increase was 10.3% from 2006 to 2009. However, the number of studies on Japanese teaching and learning as L2 at elementary level is limited.

1.2 Literature Review

There have been many studies that have examined the effect of CALL in classroom environment. Tsou, Wang & Tzeng (2006) have reported that applying multimedia storytelling website in foreign language learning was effective in developing language proficiency, story comprehension and sentence complexity of students in English classroom. Similarly, Tsou, Wang & Li (2002) have used CALL method for students to find out how computers facilitate foreign language learners to learn abstract words. In their study, the interface helped the students to learn at their own paces and teachers had little contribution to regulate the course material. Johnson et al (2005) have implemented artificial intelligence for developing serious games for learning language.

While most studies tend to focus on the reading skill or acquisition of vocabulary and grammar, studies that focus on the speech and communication development in classroom are limited. As stated by O’Brien, M.G. (2004), classroom pronunciation training should begin early, as prosody (rhythm, stress or intonation) becomes one of the deciding factors of good communication for L2 learners. She also states, “Nonnative pronunciation- what many of us refer to as a “foreign accent”- in a second language (L2) is problematic.” But as Levis (2008) mentioned pronunciation was not even classified as a topic of two prominent journals related to CALL from 2001 to 2006. A survey by Mizumachi (2006b) brings into light that there has scarcely been any work related to prosody in Japanese. The survey further suggests that, even though learners prefer Japanese training websites with multimedia features, more than 55% of the sites are text-based. The interface developed by Mizumachi (2006, p. 137) for understanding intonation of target language uses text from English and Chinese. However, dependency on learners’ first language (L1) makes it difficult to implement it especially at elementary level, where children are still in the developing state of L1. Furthermore, even though young people these days are called as digital natives who are good at dealing with digital technologies (Prensky, 2010), to design useful applications for learning it is important for information professionals to properly investigate their level of expertise (Selwyn, 2009).

Therefore, further studies are needed for developing multimodal tools that do not solely depend on text but integrate different forms or content representation such as image, audio, and video. Furthermore, such tools should fit in conventional classroom context while meeting pedagogical and technological needs of both teachers and learners.

1.3 Aim of Research and Research Questions

To address the lack of multimodal tools for elementary level L2 learners of Japanese, this study aims to understand the context and needs of language teachers. Based on the findings of user research conducted with Japanese L2 teachers at local schools, we propose the functionalities of the interface that will best serve the purpose. The usability of the interface is then evaluated by the language teachers. Finally, we discuss about future directions for developers. More specifically, this study addresses following research questions:

• What are the conventional methods used in classroom for training Japanese as second language at elementary level, and what are the challenges faced by teachers in the conventional system?
• How can multimodal tools aid those challenges?
• How should the user interface be designed so that the educators can use the tool without prior technical knowledge and suit classroom pedagogy at the same time?

1.4 Organization

The rest of this paper constitutes of the following sections. Sections 2 describes user research method and outcomes, design process of the tool based on the proposed functionalities and evaluation method.
Section 3 discusses the main findings of this study while looking at the limitations. It also discusses future directions.

2. Methodology

To propose an interface that can address classroom needs of teacher, we emphasize on understanding user needs and the context of implementation. Therefore, we adapted User Centered Design (UCD) as the method for developing interface, which is the practice of taking more human factors into account in system design (Mathis, 2011), rather than technology centered perspective.

2.1 User Centered Design (UCD)

User Centered Design is an iterative process that goes from user research to design to implementation (Mathis, 2011). We followed Mathis (2011) to generate questions for user research. Specific objectives for finding problems are 1) Find out what people are currently doing, 2) Find out what people have to do but really dislike doing, and finally, 3) Find out what they would like to be doing. Similarly, objectives for solutions are 1) Find a way of making what they are already doing easier and more efficient, 2) Find a way of making the things they dislike obsolete, or at least more fun, and finally, 3) Find a way of making what they want to be doing possible.

The user research is then analyzed and followed by design process, which involves steps like concept development, prototyping and development of the user interface. Additionally, we have followed the methods and principles of UCD from Gulliksen et al. (2003) which suggest user focus, active user involvement, evolutionary system development, simple design representations, prototyping, evaluation and holistic design. More detailed description is given in each section later.

2.2 User Research

There were three formal interviews with three Japanese language teachers from different elementary schools. All the participants were selected based on their long time experience in teaching Japanese where the average teaching year was 11. The questions of interviews were open ended, which had ensued subset of questions not mentioned in the primary questionnaire. For example,

- What type of difficulties children face while communicating in L2?
- What kind of teaching method is used to improve communication skill of kids in classroom?
- Whether the teachers have experience of using multimedia interface in classroom and or not? If yes, then what are the types of those tools?
- What type of needs cannot be fulfilled in conventional method?
- What are the difficulties felt while communicating with kids?
- What methods are used in classrooms to encourage positive interaction and hold concentration?

2.3 Deriving Key Functionalities

This section describes how we derived key functions from the outcome of user interviews.

2.3.1 Outcome of user research- phase 1 (User needs)

From the information gathered from user interviews, we extracted the common activity that needs to be supported and how can those be aided with technologies. The activities needed support and the conventional teaching methods are summarized in Table 1. We have then extracted the technical and pedagogical needs to support, as shown in Table 2.

2.3.2 Key functions of interface

Based on the findings of user research, we determined the key functions of the interface as follows:
Table 1 User needs and SL classroom pedagogy

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Activities to support</th>
<th>Conventional methods used in classroom (SLA pedagogy)</th>
<th>Use of technology in classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher A</td>
<td>Guide pronunciation of individual student</td>
<td>Natural language acquisition process by showing physical expression, read aloud, collaborative learning in pairs; i.e. native and non-native</td>
<td>Not used for teaching. Laptops are used for subjects such as Math and English.</td>
</tr>
<tr>
<td>Teacher B</td>
<td>Keep record of student’s speech</td>
<td>Read aloud, present in the target language on given subject, conversation practice between students of similar level</td>
<td>Not used for teaching. There is computer room in school but not used for language class</td>
</tr>
<tr>
<td>Teacher C</td>
<td>Guide prosodic skills to students so that the student can listen to different speaker’s pronunciation and intonations</td>
<td>Physically expressed to teach the meaning and context of using words, draw picture that describes a story and ask the student to explain</td>
<td>Not used for teaching</td>
</tr>
</tbody>
</table>

Table 2 Challenges and probable solutions

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Probable solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>The learning material should be applicable for different range of learners</td>
<td>Give teachers the flexibility to create learning material instead of offering fixed curriculum.</td>
</tr>
<tr>
<td>Individual guidance is necessary</td>
<td>Being able to follow personal response would make it possible to understand the difficulty of each student’s pronunciation.</td>
</tr>
<tr>
<td>Fit into the classroom pedagogy</td>
<td>Give flexibility to teacher to create own curriculum.</td>
</tr>
<tr>
<td>Decode the words pronounced by a user, understand the intonation</td>
<td>Be able to listen to native speaker’s response and compare with own.</td>
</tr>
<tr>
<td>Giving feedback to motivate communication is necessary</td>
<td>Provide grading option on student’s response and comment on the difficulty of particular student.</td>
</tr>
</tbody>
</table>

Customization: The freedom to customize practice lessons is given preference in the initial development of application since it was a common user need. As it is suggested from user research that, “the difference in cognitive ability of different group of children makes it difficult to generalize the set of practice problems.” So, unless a tool developer has comprehensive knowledge about that language and has teaching experience, the appropriateness of lessons for a particular target group cannot be verified. Also, in the language classroom, students can have different L1 (first) language, which can cause difficulty with particular pronunciation. To emphasize on the pronunciation difficulties particular to a L1 group is necessary to improve overall comprehensibility of the second language learner (Levis, 2007). Customization of lessons also allows the teacher to understand and guide with difficulty of individual student.

Personalization: Another important need expressed by participants was an ability to personalize the tool. Since it is difficult to follow the progress or difficulty of individual student’s pronunciation in classroom unless the guidance in classroom is 1:1, keeping record of each student’s pronunciation is one of the basic needs of the teachers. As one of the teacher said, “Personalized
training also makes it possible to study after school hours which can be reviewed by teacher later”. Therefore this function makes the interface more potent for use in different settings.

Feedback: Giving feedback on pronunciation training is another challenging issue, but is considered as an important one by the users. In teacher’s words, “even simple feedback can give the feeling of accomplishment to the children and keep them motivated.” Therefore we have focused on how to give feedback to the children so that it is easily understood and also be helpful.

2.4 Prototyping

Following the UCD method, we performed interface prototyping based on the analysis of user research. At first we focused on the technical functions necessary to meet the user needs. Then, gradually we developed the idea of user interface by prioritizing most important functions and sketching the screen transitions. Initially the prototyping was done on paper by pencil sketch. Later by using computer created a clearer graphical representation. The final implementation was done on iOS platform as described in the interface development section (Section 2.5). The second phase of interview was to evaluate the prototype. The interview time was 1 hour where the detailed functions of the interface were described using paper prototype and the user was asked whether there is any particularly difficult part and to advice on total design.

2.5 Interface development

In this study we have deployed the interface for iPad. A development middleware called PhoneGap (http://phonegap.com/) was used for coding and building the application. PhoneGap is a web-based mobile development framework, based on the open-source Cordova project (http://cordova.apache.org/) that allows using standard web technologies such as HTML5, CSS3 and JavaScript for cross-platform development. For creation of database of the system SQLite was implemented. Also jQuery was used for providing animation between screen transitions and other functions of the interface. The interface is mainly divided into two sections: Teacher’s section and Students’ section. From the home page teachers and students can access their designated pages. We implemented our key functionalities as follows.

Customization of lesson: The teacher is given the authority to create lessons for students, edit and delete. Lesson can consist of text, image and audio (Figure 1a). Personalization: Students can create own account by entering name and image (optional). Each student can practice the lessons, save their response, come back to check feedback and also listen to fellow students response (Figure 1b). Feedback: After the students respond to practice questions, teacher can review them and give feedback with number and comment (Figure 1c). Only teacher has the authority to provide and change feedback.

Figure 1. (From left to right) a. Lesson creation page, b. Students’ response page, c. Feedback page

2.6 Evaluation of Interface

The interface was later evaluated with a local teacher and their students in a real life classroom environment. We had some promising feedback about our interface. However, the full result will be reported elsewhere due to a lack of space.
3. Concluding discussions

From this study we can understand that, even though there are many technological advancements taking place, the cases where tools are used at elementary level classroom and they reflect the user needs can be limited. However, teachers do feel the need of digital tools to guide pronunciation, as it is difficult to follow each student’s progress in conventional classroom. Also it is important that the tools match the intellectual level of children, as it can be different for different age groups of students. So customization option gives the flexibility to create lessons for different group of users and by personalizing the tool, it makes it possible to follow each student’s progress. Also simple user interface and easy navigation is a must so that users can use without much prior technical knowledge.

The outcome of this study is limited due to the small number of user interviews. Since more interviews with Japanese language teachers would help to achieve further comprehensive insight of their needs, the outcomes here might not represent global needs of teachers. This multimodal interface is currently in its preliminary version, which supports simple image and audio functions. It can be augmented in many ways in future. The future upgrades can include the functions like Text To Speech (TTS) and Pitch Tracings. While the availability of TTS application for Japanese is quite low in mobile app developing environment, integration of this system would result in decreasing instructor’s labor of creating lessons by automated conversion of speech from text. Also collaborative learning should be considered in future versions since it is very common in classroom pedagogy and can be beneficial to develop better communication among second language learners.

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Enhancing English Pronunciation with
Windows Speech Recognition Training:
A Preliminary Study

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Abstract: Teacher educators have developed great interest in applying automatic speech recognition software to improve English learners’ pronunciation. However, these studies are few compared with those emphasizing on other skills such as reading and writing. This case study thus aims to fill this gap by adopting the Windows Speech Recognition (WSR) system to help English learners improve pronunciation skills and promote learner autonomy. Drawing on the Interaction Hypothesis in Second Language Acquisition, this study sought to answer two questions: (1) with the use of WSR in pronunciation training, what is learner performance of pronouncing /n/ and /l/ sounds? and (2) what are learner attitudes toward this training? The training lasted for three weeks, with one hour each time and twice a week. Data sets included a pre-test (screening test) and a post-test based on screen- and audio-recordings of training sessions, a questionnaire, and a semi-structured interview with students. Field notes were also recorded when the entire training process was observed. Findings revealed that learner performance shown in the screening- and posttest is not significant. However, it indicates that with appropriate training, it is possible for learners to understand the feedback provided by WSR and apply the knowledge to judge their own practices. In addition, since learners held positive attitudes towards the use of this software, it is suggested that teachers or tutors can integrate the software with their curriculum for improving English students’ pronunciation skills of segmental features, their learner autonomy and learning strategy.

Keywords: Pronunciation training, computer-assisted pronunciation teaching, ESL, windows speech recognition, case study

1. Introduction

With the rapid development of technology, English-as-a-second-language (ESL) teachers have developed vested interest in applying technology in their classrooms. There is no exception in pronunciation classrooms. Computer-assisted pronunciation teaching (CAPT) provides teacher educators opportunities for making pronunciation teaching and learning more approachable. Thus, automatic speech recognition (ASR) software has been widely used because it is not restricted by time and place and thus is able to offer learners practices whenever and wherever necessary. More importantly, it can serve as a private tutor to correct learners’ pronunciation. This study thus aims to adopt the Windows Speech Recognition (WSR) system to enhance English learners’ pronunciation skills and promote learner autonomy.

2. Related Literature

2.1 Use of ASR in Computer-Assisted Pronunciation Teaching

Studies on the use of ASR in pronunciation teaching are relatively few. Two concerns have been raised by previous researchers regarding the use of ASR in computer-assisted pronunciation teaching environments. The first concern is related to the fact that ASR fails to recognize nonnative speakers’
utterance as effectively as native speakers’ (Derwing, Munro, & Carbonaro, 2000). Since the database of the ASR software only collects native speakers’ speech samples, it is possible that nonnative speakers’ utterance cannot be identified by the software. Evaluating the accuracy of Dragon NaturallySpeaking® (3rd edition, 1997), Coniam (1999) examined how ten Cantonese speakers read a one-thousand-word article aloud into the computer and compared the accuracy rates produced by these speakers and those by native English speakers. Coniam calculated the accuracy rates of the identified words and clauses printed out by the computer and found that the software had a lower accuracy level in recognizing Cantonese speakers’ speech than those produced by native speakers.

The other issue concerning the use of ASR in pronunciation teaching is whether the ASR software can provide constructive feedback. This function is considered important because learners need to know which parts of their pronunciation is correct and which is not. Although the ASR software could provide instant feedback (Levis, 2007), it fails to offer constructive and accurate feedback for learners to improve their pronunciation. Researchers have addressed different concerns toward types of feedback display. For example, Neri, Cucchiarini, Strik, and Boves (2002) indicate that it is questionable to provide visual feedback displays such as spectrograms and waveforms. The idea of offering spectrograms and waveforms is to provide two comparable displays, one from the native speaker and the other from the user’s utterance. Though showing comparable displays might help nonnative users “imitate” the native speaker, it is a misconception since every native speaker produces spectrograms and waveforms differently. Moreover, visual feedback like these cannot teach users how to pronounce correctly in terms of the location of tongue or shape of lips. This indicates that visual plays are not good enough for providing constructive feedback for learners to improve their pronunciation.

In spite of the aforementioned issues, several pronunciation teachers consider it is beneficial to use ASR (e.g., Franco, Bratt, Rossier, Gadde, Shriberg, Abrash, & Precoda, 2010; Levis, 2007). With the increasing varieties of technology, teachers nowadays can use more accessible and effective systems such as Windows Speech Recognition, Google Voice, and Siri on iPhone 4S. Although these tools were not specifically designed to help pronunciation training, it is possible to develop pronunciation training based on them. In this study, we adopted Windows Speech Recognition to train adult English learners because of its accessibility.

2.2 Interaction Hypothesis

Technology has been widely used for language teaching and learning and such application is related to the Interaction Hypothesis theory. Interaction Hypothesis (Long, 1996), a theory of second language acquisition, refers to the idea that development of language proficiency is promoted by face-to-face interaction and communication. It is believed that conditions for acquisition are especially good when interacting in the second language; specifically, conditions are good when a breakdown in communication occurs and learners must negotiate for meaning. For example, when one of the participants in a conversation will say something that the other does not understand; the participants will then use various communicative strategies to help the interaction progress. Strategies used for negotiating meaning may include slowing down speech, speaking more deliberately, requesting for clarification, or paraphrasing (Brown, 2000).

The Interaction Hypothesis theory includes four components: input, interaction, feedback, and output. In the following, we will introduce the role ASR plays with these components.

Regarding Input, ASR software is usually a part of a CAPT package, which provides model inputs for learners to imitate. If not, language teachers and learners could search input from public media or trustworthy websites, e.g. Dave’s ESL Cafe, Randall’s ESL Cyber Listening Lab, Voice of America, and Ted Talk.

Moreover, according to Chapelle (2003), interaction can also happen between the user and the computer in a language learning environment. Thus, ASR software could play the role of an interlocutor and provide interactions with language learners.

One of the crucial parts of the Interaction Hypothesis is the provision of feedback. It is important because it can provide clues for learners to continue to interact with the interlocutor in order for language acquisition to occur. However, if feedback is missing after the interaction happens, acquisition might not take place. The same situation is likely to happen when the learner does not notice the feedback. Thus, feedback is considered crucial for it can create or reduce opportunities for interactions.
Last, output here refers to modified output. It indicates learners’ attempt to modify problematic utterance after they receive interactional feedback. ASR software provides this benefit because after learners receive feedback, they can try as many times as possible to practice until the feedback is given. In sum, modifying speech arising from interactions like communication breakdown helps make input more comprehensible, provide feedback to the learner, and push learners to modify their speech for better output (Long, 1996). ASR software provides input, interaction, feedback, and output for language acquisition to occur.

3. Purpose of the Study
The current study uses Windows Speech Recognition (WSR) to train learners’ pronunciation production of two sounds: /n/ vs. /l/.

Two research questions guide this study:
1. With the pronunciation training of WSR, what is learners’ performance of pronouncing /n/ and /l/ sounds?
2. What are their attitudes toward this training?

4. Methods

4.1 Participants

Participants were recruited from an ESL writing class at a Mid-western U.S. university. To identify potential participants, a pronunciation screening test was carried out to check if they have difficulties pronouncing these particular sounds: /n/ and /l/. According to Swan and Smith (2001), these sounds are commonly mispronounced by Chinese speakers. Therefore, we chose these sounds for the pronunciation training. Seven ESL students were invited to participate in the study, but only five of them completed the entire procedure. These five students (2 males, 3 females) speak Chinese as their first language and they were enrolled in diverse undergraduate programs. They were considered appropriate for the study because they were newly enrolled in the university (in their first or third semester), and they reported some pronunciation problems in their conversations with others.

4.2 Data Sets and Procedure

This study employed a case study approach (Duff, 2008) to investigate how five students participated in pronunciation training sessions. Data sets included the following:

- Pre-test (screening-test)
- Audio- and screen- recordings of six training sessions
- Posttest
- Questionnaire
- Individual interview
- Field notes based on observation of training sessions
Procedure of the study is summarized in Table 1:

Table 1: Procedure.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screening test/Pre-test</td>
<td>Pronounced /n/ and /l/ sounds in minimal pairs and a paragraph.</td>
</tr>
<tr>
<td>Training Sessions 1 &amp; 2 (Week 1)</td>
<td>Practiced the build-in tutorials to be familiar with WSR.</td>
</tr>
<tr>
<td>Training Sessions 3 &amp; 4 (Week 2)</td>
<td>Practiced /n/ and /l/ sounds with the researcher to provide instruction of specific sounds when WSR could not identify what learners had said for more than five times, or when they raised questions.</td>
</tr>
<tr>
<td>Training Sessions 5 &amp; 6 (Week 3)</td>
<td>Practiced /n/ and /l/ sounds; students needed to apply what they learned from the second week.</td>
</tr>
<tr>
<td>Posttest (two parts)</td>
<td>Part one included minimal pairs focusing on /n/ and /l/ sounds.</td>
</tr>
<tr>
<td></td>
<td>Part two included two paragraphs; the first was the same as the one used in the screening test, and the second one was new, which also included /n/ and /l/ sounds.</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>18 five-point Likert-scale items and 3 open-ended questions.</td>
</tr>
<tr>
<td>Interview with students</td>
<td>Semi-structured interviews (each lasted 15-20 minutes) for understanding students’ perceptions of pronunciation problems, use of WSR, evaluation on the training, and their potential use in the future.</td>
</tr>
</tbody>
</table>

4.3 Data Analysis

Each learner’s recording was rated by the researcher according to the focal sounds mentioned above. Paired t-test was conducted to investigate whether any difference exists between the pretest (screening-test) and the posttest. Likert-scale-item responses from the questionnaire were examined through descriptive statistics, whereas responses from the open-ended questions were coded. In addition, interviews with students were transcribed and coded by *in vivo coding* and themeing the data (Saldaña, 2009, p. 74 & 139). Questionnaires and interviews were both used to triangulate the data.

5. Results and Discussion

5.1 Learner Performance

The screening and posttest contains two parts: minimal pairs and paragraphs specifically designed to elicit discrimination of /n/ and /l/ sounds.

Table 2: The accuracy rates (%) of /n/ and /l/ in minimal pairs and paragraphs.

<table>
<thead>
<tr>
<th>Student</th>
<th>Minimal pair: /n/ vs. /l/</th>
<th>Paragraph: /n/ vs. /l/</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Screening-test</td>
<td>Posttest</td>
</tr>
<tr>
<td>1</td>
<td>86</td>
<td>93</td>
</tr>
<tr>
<td>2</td>
<td>93</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>93</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>93</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>79</td>
<td>93</td>
</tr>
<tr>
<td>Average</td>
<td>89</td>
<td>97</td>
</tr>
<tr>
<td>SD</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2 provides the accuracy rates of /n/ vs. /l/ in minimal pairs and paragraph level. The average of /n/ vs. /l/ in minimal pairs and paragraph level in screening-test is 89% (SD = 6%) and 82%
(SD = 21%); and that in posttest is 97% (SD = 4%) and 94% (SD = 9%). Although the difference is not significant, the increasing trend may suggest that by using WSR in pronunciation training with some training to interpret the output, it is possible for students to improve their pronunciation, even by practicing alone.

5.2 Learner Attitudes

Students’ attitude is a prominent factor in mastering a second language (Lightbown & Spada, 2006). Multiple sources (questionnaires, field notes, student interviews, and learners’ screen- and audio-recordings) revealed that learners held positive attitudes towards the pronunciation training with the use of WSR and believed that the training was effective.

During their practice, learners tended to repeat each word several times. When asking about the reason, they responded that they wanted to see the WSR output, namely what word would show up based on their speech. However, they reported that they were annoyed when WSR showed the wrong words around five times. If this happened, they would ask the researcher why it was like this and how to pronounce the word correctly.

Moreover, the participants revealed that they were willing to practice as many times as possible, around eight to ten times on average. They were able to make slight changes and found out in what way the WSR could show the correct word on the screen. This implies that the use of WSR could promote learner autonomy and help learners acquire learning strategies, such as self-correction and self-monitoring.

The effectiveness of the training went beyond our expectations. In addition to the two sounds designed for this study, Participant 3 reported that he learned how to say /θ/ sound (as in three) and Participant 2 understood that “four” does not have the same pronunciation as “full.” Participants 2 and 5 reported that they learned to distinguish the sounds of these words: “napkin” rather than “lapkin”; “thank you” rather than “sank you.” Participant 4 even invited her friends to try WSR when they were in a party. All in all, WSR provided opportunities for the ESL students to practice, modify, and produce correct output.

6. Conclusion and Implication

The use of WSR seemed effective in pronunciation training because it could help learners improve pronunciation skills and promote learner autonomy and develop learners’ self-correction and self-monitoring strategies. Although WSR could not accurately capture nonnative speakers’ sounds, this motivates learners to practice again and again. With adequate training, learners are able to monitor their utterance and self-correct their speech. The use of WSR helped develop learner autonomy, enhance learning strategy, and improve pronunciation skills of segmental features.

Since this study adopted a case study approach, it only included five participations. For future research adopting quantitative methods, a larger sample size could be considered. This study has some limitations. It was completed within a short time period (three weeks). Therefore, it is suggested that a longer period time for training and a larger sample size may have different impact on the results. Second, since this study only examined the effects of training on learners’ pronunciation of two sounds, future studies can incorporate other sounds that may be challenging to English learners, such as /θ/ or vowels such as “fat” vs. “fate.” Third, this study was conducted in the United States, future research could be undertaken in other countries where students use English as their foreign language (EFL). How these learners use WSR might be different from ESL learners in English-speaking countries. Their perceptions of use and difficulties can provide researchers better understanding. Finally, since this study did not include any native English-speaking instructor, to what extent the combination of a native English-speaking instructor and the WSR can provide opportunities for learners can be examined.
Acknowledgements

We would like to thank the five participants for making this research possible. Without their help, we would not have been able to begin this research.

References

Exploring the Value of Multimedia Messaging Service for Learning English Reading: Using LINE as an Example

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Abstract: The development of mobile technology is rapidly changing the environment and the way of learning in school. In addition to facilitating communication, mobile devices (e.g., smartphones and tablets) have made ubiquitous E-learning more accessible and mobile learning more popular. Multimedia messaging service (MMS), such as WhatsApp and LINE, can deliver richer information, including images, audio and video files, to enhance the interest of English learners. However, whether MMS can help students learn English is of interest. The purpose of this study is to investigate the value of MMS, LINE in particular, in helping EFL students learn English, based on the concept of Dual Code Theory (Paivio, 1986). The participants are 40 college students enrolled in Freshman English Reading course. Data collection consists of pre- and post-test, MMS messages, questionnaire, student writing, and interviews. It is noted that this study is currently ongoing. Based on the comparison of students’ pre- and post test, the preliminary findings indicate that the LINE-based learning activities helped students familiarize with English vocabulary and improve English reading comprehension. In addition, students who were more engaged in the LINE-based activities tended to have better improvement than those who were less active. While most students made improvement and had positive perceptions of the designed activities, some did not seem to benefit from the instructional design. More detailed description will be addressed upon the completion of the study.

Keywords: Information technology, mobile learning, English reading and writing, MMS, LINE

1. Introduction

With the rapid development of information technology, students are used to learn different dimensions of knowledge through various devices such as computers, notebooks, tablets, and smart phones. A considerable amount of literature has been published on the use of information technology in assisting teaching and learning (i.e., computer-assisted language learning (CALL) and electronic-learning (E-learning)) (e.g., Greenfield, 2003). These studies indicate that the use of information technology is beneficial when integrated in traditional learning environments.

The rising speed of mobile technology is increasing and has made ubiquitous E-learning more accessible and mobile learning more popular. Mobile technology is gaining much attention because of its characteristics such as mobility, reachability, personalization, spontaneity, and ubiquity, and its promises for education (Saran & Seferoglu, 2010). Mobile devices allow a richer learning environment for language learners (Yousefzadeh, 2012). Several attempts have been made to understand the benefits of mobile learning (M-learning) and mobile-assisted language learning (MALL) (Chen & Hsieh, 2008; Kiernan & Aizawa, 2004). These studies demonstrate the potential of mobile devices and applications in enhancing language learning.

Recently, many smart phone-based applications have been developed such as short messaging service (SMS) and multimedia messaging service (MMS). The use of SMS and MMS with mobile devices in facilitating English learning is gaining much attention. For example, Saran and Seferoglu (2010) have explored how to support foreign language vocabulary learning through multimedia messages via mobile phones. Yousefzadeh (2012) found that learning vocabulary via MMS resulted in
better learning than learning vocabulary via SMS. However, most SMS- or MMS-based studies have focused mainly on the learning of English vocabulary and very few studies have explored the learning of English through instant and interactive conversation. As mobile learning is gaining much popularity, the viability of MMS in learning English is worthy of investigation.

Therefore, the purpose of the study is to investigate how MMS, LINE in particular, supports English learning. The study aims to examine how LINE assists students’ learning of English reading. The findings of the study play a significant role in defining the role MMS (i.e., LINE) plays in supporting language learning.

2. Literature Review

2.1 Multimedia Learning

As information technology becomes available, more and more teachers incorporate multimedia materials in teaching practices for the value of entertainment and comprehension (Gilakjani, 2012). Multimedia refers to “any computer-mediated software or interactive application that integrates text, color, graphical images, animation, audio sound, and full motion video in a single application” (Gilakjani, 2012, p. 57). Multimedia materials help students comprehend complex issues and improve learning. Gilakjani (2012) argued that the use of two different modalities (i.e., visual and auditory) to present information contributed to such improvement. According to Paivio’s Dual-Code Theory (1986), learning improves when the information is received through two channels (i.e., visual and verbal) to construct meaning. Some studies have proved such theory valid (Plass & Jones, 2005; Chen, Hsieh & Kinshuk, 2008). Plass and Jones (2005) argued that multimedia could enhance input by making it more comprehensible. Similarly, Chen, Hsieh, and Kinshuk (2008) examined how SMS and MMS facilitate the learning of English vocabulary and found that using more than one modality is more effective than the use of a single modality. The different modalities of information presented in multimedia materials allow the language learners to increase comprehension of the materials and facilitate learning.

2.2 Mobile Messages and Language Learning

An increasing number of young users in Taiwan are communicating with each other through mobile messaging applications, short messaging service (SMS) or multimedia messaging service (MMS), such as Whatsapp, LINE, Viber, and WeChat. MMS is an evolutionary form of SMS; it can send not only text but also graphics, video, and audio clips (Tayebinik and Puteh; 2012). As multimedia instruction offers a more engaging and lively learning environment, designing English courses with the use of MMS seems to become an important issue. Several studies have compared the use of SMS and MMS in English learning and found MMS-based instruction to be more engaging and effective, which is in line with the Dual-Code Theory (Paivio,1986) and the cognitive theory of multimedia learning (Gilakjani, 2012). For example, Yousefzadeh (2012) investigated how the uses of SMS and MMS via smart phones affect English vocabulary learning of 50 elementary level learners. Students in the MMS group received English vocabulary with definition, pictures and examples, while the SMS group received only English vocabulary with definition. The findings indicated that MMS had a substantially higher information-carrying capacity than SMS, and the achievement scores in the MMS group were significantly increased. Similarly, Chen, Hsieh, and Kinshuk (2008) pointed out that learners receiving English words along with both written and pictorial annotation via mobile messaging service had better learning outcomes than those receiving only English words without written or pictorial annotation. In other words, the use of visual media enhances English vocabulary acquisition.

Up to now, however, only few studies have explored how MMS affects foreign language learning. Previous research on SMS- or MMS-based English learning has tended to focus on having students passively receive instruction from the researchers or teachers via mobile phones, instead of interacting with their peers. According to one of the suggested principles for multimedia learning, “multimedia learning is more effective when it is interactive and under the control of the learner” (Gilakjani, 2012, p. 59). This means that MMS-based activities would be better received when learning through instant and interactive conversation.
Currently, LINE is one of the most popular MSM applications among young students in Taiwan. Launched in Japan in 2011, LINE is an app for instant messaging on smart phones and PCs. LINE is more of a social entertainment network, in addition to a messaging app. It provides free voice calls, instant text messages, games, and built-in camera. The cartoon characters and stickers serve as emoticons to make communication more interesting. It has become the most popular mobile messenger app in Taiwan, according to the market research of InsightXplorer Limited, as of May 2013. The official website of LINE pointed out that, as of the end of November 2013, the app had 300 million users worldwide; Taiwanese users of LINE had reached 17 million, second only to Japan (50 million) and Thailand (20 million), and most of the registered users are younger generation.

Due to the popularity of LINE, it is hoped that such technology can be leveraged to support English language learning. The purpose of the study attempts to explore how the use of MMS supports learning English reading by engaging students in interactive role-playing activities. This study is guided by the following research question: What the viability and challenges of LINE-based mobile learning are for English language education.

3. Methodology

3.1 The Research Context and Participants

This study is conducted at a university located in a suburban area of northern Taiwan. The participants involved in the study are 40 students who enrolled in the Freshman English Reading course in spring 2014. The 18-week course is offered by the Department of Applied English. The course is a required course with four credits for English majors and is scheduled four class hours per week.

3.2 Instructional Design

The Freshman English Reading course aims to help students understand and interpret English in its written form on a variety of topics. Students will comprehend written texts through use of reading and vocabulary learning skills. The instructional design consists of two elements: in-class instruction and after-class MMS-based activities.

Each week the course focuses on one reading text about themes such as earth science, tourism and hospitality, and animal studies. In-class instruction introduces vocabulary and language expressions to each theme. Some exercises for reading comprehension and reading skills will also be included for practices.

The MMS-based learning activities utilize the concept of Dual Code Theory (Paivio, 1986), which is designed to engage students in contextualized scenarios where students read, speak, write and interact with each other. Students form groups of three or four for the activity. Toward the end of each class, students receive role cards that explain their roles and tasks. They decide which role they would like to take on according to the role cards. Students then follow the tasks on the role cards to prepare for information, materials, etc. needed for their conversation.

After each class, students participate in the role-playing activities through LINE. Students are instructed to use what they have learned in class to communicate with their group members. They are also encouraged to include photos, video clips, links, or any information that will facilitate their communication. Figure 1 demonstrates the examples of LINE messages.
3.3 Implementation

The implementation include three elements: perform pre-test and post-test, implement the MMS-based activity, and conduct student questionnaire and interview. The study utilizes the pre-test and post-test design to examine students’ English proficiency in Freshman English Reading course before and after the experiment. At the beginning of the semester (first week), the participants were asked to take a test of English reading (pre-test) to determine English proficiency level of the students. At the end of the semester (17th week), the participants will take the same test of English reading (post-test) to access their improvements during the experiment. Throughout the semester (2nd-16th weeks), the students are asked to participate in weekly role-playing activities after class using the vocabulary and language expressions introduced in class. At the end of the semester (17th-18th weeks), student perceptual questionnaire, and student group interview will be conducted. The students will be asked to fill out the student perceptual questionnaire in the last class of the course. Additionally, they will be invited to participate in group interviews for the researchers to further understand their experiences and reflection on the MMS-supported English learning.

3.4 Data Collection

Data collection consists of five sources: pre- and post-test, MMS messages, writing samples, student perceptual questionnaire, and group interviews with students. A pre-test is prepared to test the participants’ proficiency level of English vocabulary and reading skills. The test consists of 30 items including multiple choice, cloze test, and single/double passage reading comprehension. The same test will be re-administered with the order of the items changed as a post-test.

All of the messages delivered via LINE during the weekly MMS-based activity are gathered. When students participate in the activity via LINE, they were asked to include the researcher’s account in their conversation so that all the MMS messages can be recorded. Student writing assignments in relation to the MMS activities are collected. After students participated in the MMS activity, they wrote an assignment based on their discussion in the activity. The writing assignments were designed to strengthen students’ understanding of vocabulary and reading texts learned in class.

The questionnaire design is used to identify students’ learning experiences and reflections on MALL and MMS. It was designed to investigate the students’ perceptions of group activity with MMS via smart phones. It comprises of two sections of questions: checked items and open-ended questions. A 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree) is used in the checked questions, categorized into three aspects: technological device, MMS, and the role-playing activity. The open-ended questions asked the students about their learning gains benefited from the activity and
through technology, challenge encountered, self-reflection on the activity and technology, and suggestions to future teaching design.

All of the students will be invited to participate in the group interview at the end of the course. The semi-structured interviews will address four main questions: prior experiences with mobile- and MMS-based learning, current learning experiences, individual effort and group interaction, and overall reflection. Each interview will last about 30 minutes. All the interviews will be digitally recorded.

3.5 Data Analysis

The quantitative data will be processed with the statistical software, Statistical Package for Social Science (SPSS), including descriptive statistics, t-test, and correlation. Specifically, results obtained in the pre- and post-test will be compared in order to determine the effects of LINE on learning outcomes of English vocabulary and reading. For the student perceptual questionnaire, descriptive statistics will be performed; the mean scores and standard deviation of the questionnaire will be calculated to explore the participants’ attitudes toward the use of mobile phone and the overall MMS. Word count will be used to analyze the MMS messages to assess student learning performance.

In addition, content analysis will be utilized to analyze qualitative data. Students’ interview transcripts and responses to the open-ended questions will be analyzed using category construction (Erlandson et al., 1993) to code the data into emergent categories.

4. Preliminary Findings

As mentioned, this study is currently ongoing. The preliminary findings reveal that the students, overall, had positive perceptions of the MMS role-playing activities; many of them reported that the MMS role-playing activities helped them familiarize with new vocabulary introduced in class and hone their reading skills. In addition, LINE, as a learning platform, reportedly was convenient and fun to interact with peers. Based on the comparison of the students’ pre- and post-test, the students who made conversation more frequently used more focus vocabulary in the role-playing activity and subsequently had better improvement in the test. Several challenges, however, were also reported, including (a) collaboration with group members who are not too responsive, (b) availability of teacher feedback, and (c) flexibility of time for instant conversation. More detailed description will be addressed upon the completion of the study.

5. Acknowledgement

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References

Gender Differences in Flow State in an English Learning Environment Achievement System

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Abstract: In recent years, a growing number of studies have been conducted on the individual differences in digital game-based learning (DGBL). Despite this growing interest, there is a lack of sound empirical evidence on individual differences (e.g., gender differences) in flow state in achievement systems in English learning environments. This study investigated whether any gender differences existed in such a system. To this end, the current study developed an achievement system including a reward mechanism-based design with learning features (i.e., interaction and rewards for correct answers) to facilitate English learning. An experiment was conducted. A total of 50 respondents participated in the study. Data were analyzed using independent sample t-tests. The results revealed that the female respondents had significantly higher mean scores for flow state than the males.

Keywords: Achievement system, English learning, flow state, gender, reward mechanism-based design.

1. Introduction

Recently educators have focused on digital game–based learning (DGBL) for language learning. In authentic use, however, the perception of flow state in the digital games used in the foreign language classroom remains limited for individual learners. Individual differences could be caused and sharpened by a learner's average intelligence, special ability, gender, and so on. The increasing individual differences make DGBL systems more difficult to design for each English language learner.

Numerous studies have attempted to explain the benefits of digital games in learning (Ronimus, Kujala, Tolvanen, & Lyytinen, 2014). For example, during play, children practice skills (De Grove, Bourgonjon, & Van Looy, 2012) and actively solve meaningful problems (Price & Rogers, 2004).

Recently, researchers have begun to focus on the elements that comprise game-based learning (Wilson et al., 2009) such as achievement-based reward systems, and rewards and achievement associated with game rules (Charles, Charles, McNeill, Bustard, & Black, 2011) that provide missions and objectives to challenge players for rewards. Rewards are a kind of positive feedback which encourage the player to continue the game, and providing fun and experience (Wang & Sun, 2011).

One fundamental aspect that is often included in the “rewards based mechanism” of a game is the ability of the game to create a flow state for the gamer. Potential control is one of the antecedents of flow (Finneran & Zhang, 2003) which leads to improved learning outcomes (Skadberg & Kimmel, 2004) by achieving a reward. In addition, Wang and Sun (2011) mentioned that flow state is generally used to analyze the rewarding experience of the learner. They used three of the characteristics of flow state to analyze how reward systems offer positive experiences: balance between challenge and skill, clear goals, and immediate feedback. In addition, different players have different flow states during a game. For example, different genders’ performance differs while playing. Boys tend to focus on the achievements whereas girls are more likely to be concerned with building relationships with other players (Williams, Consalvo, Caplan, & Yee, 2009).

The current study designed an achievement system including a reward mechanism (i.e., expected and unexpected rewards) for a game-based English learning environment, with the aim of investigating whether there were any gender differences in the flow state while using the system.
2. Literature review

2.1 Gender differences

Numerous studies have been conducted to explore the effect of gender differences on performance in games. Wood, Griffiths, Chappell, and Davies’ (2004) study found significant gender differences in relation to some of the game dynamics such as males rating skill development significantly higher, and preferring shooting and a variety of different forms of transportation within a game compared to females. On the other hand, significantly more females preferred solving puzzles, avoiding things (e.g., dangerous places, spells), and finding important things, and were more in favor of points accumulation than males. Inal and Cagiltay (2007) mentioned that gender differences played an important role in children’s game preferences. They found that boys preferred fighting or war games whereas girls preferred Barbie-like games. Heeter, Lee, Medler, and Magerko (2011) found gender differences in an achievement system. For example, boys generally emphasize performance and super-achievement, while on the other hand, girls are more likely to be classified as non-achievers, with low performance and mastery gaming achievement goals. They are also less motivated by exploration or achievement. Females are more likely to prefer to play alone, and dislike competing to outplay other players.

2.2 Flow state within an achievement system

The present study defined flow state as one’s engagement, fun/enjoyment and control while participating in an achievement system. Previous work has proposed that these indicators (engagement, enjoyment, and control) can be used to provide an overall impression of flow while learning (Trevino & Webster, 1992). A flow activity is one in which the mind becomes easily focused and engaged in an activity and learning (Whitson & Consoli, 2009), which makes it of particular interest to the serious games community, for whom engagement and learning are key concepts. Thus, engagement in an activity is a fundamental aspect of flow experience, setting the foundation for continuing learning. Other flow activities, including intellectually demanding tasks, can also be enjoyable and satisfying, and can enhance creative accomplishment and satisfaction. Such feelings may occur mainly in retrospect because all concentration is focused on the task during actual engagement (Csikszentmihalyi, Kolo, & Baur, 2004). One’s potential control leads to improved learning outcomes (Skadberg & Kimmel, 2004).

In this study, we use the concept of flow (Csikszentmihalyi et al., 2004) in an achievement system including a reward mechanism which allows learners to continue their English learning activities. Moon, Jahng, and Kim (2011) argued that the reward system in a game is recognized as one of the most important mechanisms to engage players in active sustainable digital game playing. As Chen et al. (2009) proposed a game-based learning system including learning features such as being competitive, interactive, and visible, to design a reward mechanism-based trading card game, which was used to stimulate learners’ motivation and increase their willingness to use it. The current study developed an achievement system including a reward mechanism to see whether gender differences have any impact on learners’ perceptions of flow state within the proposed system.

3. Research method

3.1 System design and implementation

There are two parts to the achievement system design, the architecture of the system and English learning activities. The descriptions of these two parts are given below.

3.1.1 Architecture of the achievement system

In the achievement system, the rewards can be divided into two categories, that is, expected and unexpected reward achievement. Expected reward achievement allows learners to obtain the game goal, which is one of its criteria. For unexpected reward achievement, learners are faced with different
challenges. Once they can tackle the different situations in the game, they will have rewards and enhance their gaming experience.

There are two kinds of expected rewards, learning rewards and interactive rewards, where learning rewards are gained by answering multiple choice questions and completing problem sets. In this design, the learning rewards are designed to encourage the learners to answer the questions so as to gain the desired rewards. The more questions that are answered correctly, the better ranking will be achieved along with gaining the rewards. Interactive rewards consist of playing ball, jump rope and shopping. The design of these interactive rewards allows learners to try a variety of games in the achievement system which will enhance their gaming skills. Thus, they are not only able to develop their gaming skills, but can also buy things. For the unexpected rewards, there are three kinds of reward achievement, namely teaching, mastering, and collecting. Thus, learners will become familiar with the system through achieving rewards. After finishing the game and fulfilling the reward requirements, the learner will get immediate feedback, as shown in Table 1. This feedback system helps students to understand their gaming goals. In this way, learners will be motivated to pursue a variety of challenging goals in the game as well as enhancing English learning. In this system there are many criteria such as progressive achievement, which is designed for the learners to face the challenges of similar tasks with many difficulties. Progressive achievement provides status rewards including gold, silver and bronze rewards. In the game, the learner needs to achieve bronze, then silver, and finally gold. The different levels of icon are shown in Table 1.

Table 1: After achieving reward with different levels of reward icon

<table>
<thead>
<tr>
<th></th>
<th>Expected</th>
<th>Learning</th>
<th>Bronze</th>
<th>Silver</th>
<th>Gold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MCQ-1</td>
<td>Stone+2</td>
<td>Stone+2</td>
<td>Stone+3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MCQ-2</td>
<td>Stone+3</td>
<td>Stone+3</td>
<td>Stone+4</td>
</tr>
<tr>
<td>Interactive</td>
<td>Play ball</td>
<td>Power+5</td>
<td></td>
<td>Power+10</td>
<td>Power+15</td>
</tr>
<tr>
<td></td>
<td>Jump rope</td>
<td>Power+5</td>
<td></td>
<td>Power+10</td>
<td>Power+15</td>
</tr>
<tr>
<td></td>
<td>Buy something</td>
<td>Money+50</td>
<td></td>
<td>Money+100</td>
<td>Money+150</td>
</tr>
<tr>
<td>Unexpected</td>
<td>Understand game</td>
<td>Teach</td>
<td>Water+1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master</td>
<td>Money+300</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Collect</td>
<td>Money+500</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.2 English learning activities

After logging the game, the learners are able to see the English learning content which is consist of alphabets, words and sentences. These three contents were chosen because language learning starts with lower to higher-level representations. The exercises of the learning content are designed as multiple choice questions (MCQ) and problem sets. In the process of learning activities there were a total of 360 questions where learners need to practice. Participating MCQ a learner can achieve different virtual reward and feedback. Rewards are provided by performing English learning activities from the English learning contents of the system.

Hamari and Eranti (2011) mentioned that game rewards can affect players’ performance. In the achievement system design an English learner can have a reward which is visible on the screen, as shown in Figure 1(a). The system shows the rewards in words and pictorial representation. Therefore, learners may choose their desired rewards. Before they get the reward, it is shown in dark on the screen. After receiving the reward the color will change to bright. Then, learners can take challenges to win more difficult rewards by performing English learning activities. Once they finish the challenge, the system will inform the learner of their completion of the goals and of the rewards they have gained. The
achievement system will show the rewards they have acquired by English learning, as in Figure 1(b). Learners can see the acquired rewards, the grade and the quantity of rewards. The learners could then prepare for the next challenge in the game.

3.2 Instruments

There are two kinds of research tools used in this study. Table PCs were used as the hardware, and a questionnaire was developed to survey the learners’ flow state performance while using the achievement system. A total of 11 question items were developed for identifying the players’ flow state. The questionnaire was adapted from Pearce, Ainley, & Howard, (2005), and was slightly modified to fit the present study context. There were four questions for control, four for fun (enjoyment) and three for engagement. Each item was rated on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha for the flow state items was .82.

3.3 Participants and procedure

The questionnaire was distributed to third grade students of an elementary school in northern Taiwan, in a paper-based format. A total of 53 students participated in this study, three of whom did not complete the questionnaire, giving a valid sample of 50 (94%). There were 26 (52%) males and 24 (48%) females. The respondents were 9 to 10 years old.

An experiment session was conducted once a week for two times. The total time of the three experiment sessions was about 140 minutes. The students were first introduced to the features and usage of the system including the tablet and the game with the achievement system. The researchers then guided the students through all of the different types of English learning activities. The students took turns test driving the system, and their reactions to and interactions with the system were captured.

4. Results

4.1 Learner’s activity on achievement system and gender differences in the use of the achievement system

Activity on achievement system and the results of the t-tests are presented in Table 2. As can be seen, the female respondents’ number of view times is higher than that of the males. Independent sample t-tests were used to compare the differences between the male and female learners in their use of the achievement system and flow state. In Table 2, the results portray that the male respondents had higher mean scores for interactive rewards, learning rewards, unpredictable rewards and total number of rewards than the females. The t-test results show that the difference between the males and females for the interactive dimension’s mean score was significant (t = 2.10, p <0.05) but for the other values it was not. Compared to the female (5.29) respondents, the males (6.04) achieved more interactive rewards in the achievement system.
4.2 Gender differences in the flow state in the achievement system

In Table 3, the results portray that the female respondents had higher mean scores for flow state than the males. The t-test results showed that the difference between the males and females in the flow state dimension’s mean score was significant ($t = -2.50, p < 0.05$). Compared to the male (46.28) respondents, the females (49.42) were more involved in the pursuit of the goal rewards in the achievement system.

Table 3: Gender differences in the flow state

<table>
<thead>
<tr>
<th></th>
<th>Gender</th>
<th>Number of respondents</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow state</td>
<td>Male</td>
<td>26</td>
<td>46.28</td>
<td>5.35</td>
<td>-2.50*</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>24</td>
<td>49.42</td>
<td>3.38</td>
<td></td>
</tr>
</tbody>
</table>

*P<.05

5. Discussion and conclusion

The results of this study showed that gender differences played a significant role in predicting individuals’ flow state, and that the female respondents had higher mean scores for flow state than the males. Taken together, these findings affirm the predictive power of the gender role theory, and highlight the importance of including gender as an independent variable in future work among game-based learners.

The several findings will be covered individually, followed by a discussion of the related theory. At the broadest level, the findings support past research (Wood et al., 2004) which has found that more females than males prefer accumulating points and finding bonuses. In this study, one of the features of the achievement system, “buying clothes,” influenced girls’ behavior more than boys’ and enhanced the girls’ contribution to the game, while the boys were easily influenced by other factors of the game. In addition, when the learners could see their game ranking among all learners, they were more competitive and discussed the game with others, which enhanced their motivation and accomplishment of the goal. As predicted, the male students achieved more interactive rewards than the females, and there was a significant difference while interacting with special characters, such as aliens. Our results are quite similar to those of Heeter et al. ’s (2011) study in which they found that males were significantly more likely than females to be super-achievers while interacting. Thus, interaction is needed as they found that interaction was high among group members when the learners found a new game or after they achieved a given task in a game. While interacting, Inal and Cagiltay (2007) mentioned that flow experience mostly occurs among group members while they are working on difficult levels of a game and after they pass to the next level. Their results revealed that flow experience occurs more often among boys than girls during gameplay, which is quite similar to the interaction part of this study.

One of the limitation of this study is the experiment time was short (i.e., only two times), due to their regular classes, school activities, school examinations and a time limit on the game play. It is
suggested that future research could allocate more time for the experiment; then, the understanding of learners’ perceptions of flow state in an achievement system for learning English will be better. One of the implications of this study is that educators could be better informed to think about how to leverage the differences in individuals’ to come up with better pedagogical DGBL designs to improve their students’ English learning performance.

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References


MULTIMEDIA DEVELOPMENT OF ENGLISH VOCABULARY LEARNING IN PRIMARY SCHOOL

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Abstract: This research study is aimed at: (1) developing multimedia of English vocabulary instruction in year-five of the elementary school, (2) revealing the quality of the developed instructional multimedia viewed from the aspects of content, instruction, appearance, and programming, (3) revealing the aspect of attraction of the developed instructional multimedia, and (4) revealing the learning mastery of the students after using the developed multimedia. This study was developmental research. The research validators included one expert in English education and one expert in instructional multimedia. The research subjects consisted of three students for the one-to-one try-out and twenty students for the large group try-out. The instruments employed in this study were a questionnaire, observation guide, and pre-test and post-test. The data were analyzed by using descriptive statistics. The findings of the study are: (1) the development of English vocabulary instructional multimedia in year-five of the elementary school proceeded in six steps, namely, analyzing, designing, producing, validating, revising, and trying-out; (2) the quality of the developed instructional multimedia viewed from the aspect of content, instructional, appearance, and programming is good. The score range of 1 to 5, the content aspect shows a mean score of 3.75, the instructional aspect shows a mean score of 3.71, the appearance aspect shows a mean score of 3.87, and the aspect of programming shows a mean score of 3.75; (3) the aspect of attractiveness shows that the developed instructional multimedia was very interesting: in the one-to-one tryout, of the three students observed, two students indicated that the product attraction was very interesting, and one student indicated that the product attraction was interesting; in the large group try-out, of the twenty students observed, twelve students indicated that the product was very interesting, and eight students indicated that the product was interesting; and (4) learning by using instructional multimedia has good impact on students’ mastery learning: in the large group try-out, out of twenty students, nineteen students (95%) have accomplished mastery learning in the English vocabulary instruction.

Key words: development, multimedia, vocabulary

1. Introduction

English learning in primary school during this time is still using conventional method. In teaching the teacher only rely on the classical lecture method. The teacher is not using the other media besides book. Learning methods like this does not fulfill the principles of effective learning and empowering the students potential. Based on the statements above, both teachers and students in primary schools are needed to innovate the instructional media. Basically the media is supporting facilities which are used in teaching so that educators can transfer the material easier. In using the media we must see what things that we are going to give to the students. The instructional media innovation is used to improve the quality of learning.

One of the products of technology that can be used as an innovation in learning is computer. As it is said by Ruseffendi (1984:420) that, learning media which is based on the computer can make the students’ behavior become positive. One of the advances in information technology and communication is multimedia. Molenda said that today examples of multimedia education and training include slides with synchronize audio tapes, videotapes, cd-roms, dvd, the worldwide web, and virtual reality (Molenda, 2005:141). By using multimedia it is expected children more interested in knowing the information. The more quality applications from the media, the more children have a lot of variety in learning so that the learning activities will be no bored, especially in English. English as one of the education which is provided to children will be delivered easily to the child by using...
multimedia. Introducing English from an early age children are expected can master and communicate by using the English language. Multimedia can be used to support the learning process.

2. Multimedia

According to Barker & Tucker (1990) multimedia is defined as a collection of various different media equipment used for presentations. Tan Seng Chee & Angela FL Wong (2003: 217) states that traditionally multimedia refers to the use of multiple media, whereas in today's multimedia refers to the combined use of multiple media in the presentation of learning through computers. Hackbarth (1996: 229) emphasizes that hypermedia and hypertext, including computer-based interactive multimedia. Philips (1997: 12) states that interactive multimedia has potential to create a multisensory environment that supports a particular way of learning.

Agnew, Kellerman & Meyer (1996: 8) states that the term multimedia is more focused on the interactivity between the users of the media with the media. Constantinescu (2007: 2) states that "Multimedia Refers to computer-based systems that use various types of content, such as text, audio, video, graphics, animation, and interactivity". Multimedia which is developed in this study is a multimedia in english vocabulary learning for the fifth grade of primary school. This study develops a tutorial model of learning multimedia that can be used in learning both classical and individually. The language learning on the aspects of English vocabulary learning in this study is based on one of the characteristics of elementary school student Schematic of the multimedia components can be seen from the figure below:

![Schematic picture of Multimedia Components](image)

Figure 1. Schematic picture of Multimedia Components

3. Vocabulary

Abu Bakar Suleiman, A. Gani & Syafri K. (1986: 6) states that the word is derived from Sanskrit vocabulary Koca and katha. Both words are absorbed into Indonesian as a compound word. Without extensive vocabulary, a person will not be able to use the structure and function of language in communication in a comprehensive manner. Tarigan (1986: 2) states that a person's language quality depends on the quality of the language vocabulary possessed. The richer vocabulary possessed, the greater in using the language.

One of the reasons why teachers learnt vocabulary is to facilitate the students in improving reading comprehension (Pikulski & Templeton, 2004: 5). Knowledge of vocabulary is the center of expertise in the language. Therefore, learning vocabulary is something that is very important. Learning vocabulary in this case concerns the teaching and learning vocabulary. Nation (2001: 107-108) mentions three procedures of vocabulary teaching, namely: recycled words, the second-hand cloze, and the vocabulary interview.

4. The using of Multimedia in Vocabulary Mastery

English vocabulary mastery is really important in order to communicate something, if someone choose the wrong vocabulary in a sentence it will give significant effect to the sentence, as stated that “Research has shown that lexical errors tend to impede comprehension more than grammatical errors, and native speaking judges tend to rate lexical errors as more serious than grammatical errors” (Schmitt, 2000:155). Mastery of vocabulary also obtain for the native speakers’ themselves. So it can be said that someone has mastered the vocabulary if a learner can communicate with someone effectively. According to Wood (2001: 15), the use of multimedia learning has potential to improve learning vocabulary. In multimedia learning can be presented in the form of games, hyperlinks, hypertext, and animation.
5. RESEARCH METHODOLOGY

This research is a developing research. According to Borg&Gall (2003:772), the development of research is oriented research in developing and validating the product which is used in education. The same thing also expressed by Gay (1981: 10) that development research is not to create a theory or test the theory but to develop effective products to be used in school.

In this study, model which suitable is a model of research development Borg & Gall (2003: 775) and the development model of instructional design Dick, Carey & Carey (2005: 1). The development model adapted to produce a simpler model of development, which serve as a foundation in research.

This research through six phases as the following. First is the requirement analysis phase. The purpose in this stage is to collect information which is relevant with the requirement for the development of multimedia learning English vocabulary of fifth grade elementary school. The second is the instructional design development. The purpose in this stage is to develop the instructional design to produce a syllabus as a basis for developing multimedia learning. The third is the stage of production or multimedia development. The purpose in this stage is to produce the initial product, and subsequently tested or implemented in a computer to determine if the results are expected or not. Fourth is the expert validation stage. This stage is to determine the feasibility of the product which is developed. Fifth is revised. This stage is to improve the quality of products based on the suggestions from the material experts revision and media experts. Sixth is to test the product. This phase was conducted to determine the attractiveness of multimedia which is developed for students and to get the results of pre-test and post-test.

Validator of the study consisted of one person material experts and a media expert. The material expert is assessing the content aspects and learning; media experts is assessing the aspects of the display and programming. Subject of research is the students of Elementary School fifth grade in SD Bakti Mulya 400 numbered twenty-three students. In one-on-one trials involving three students consisting of two male students and one female student. While the trial involves a large group of twenty students is seven boys and thirteen girls. The age of students who take the test ranged from 10 to 12 years.

The data collection instrument which is used was a questionnaire, observation, pre-test and post-test. Questionnaire was used to obtain the data which is related to the quality of materials and quality of media feasibility. Observation is used as a guide in making observations on the attitudes of the students during the process of testing to determine the attractiveness of the product for students. The pre-test and post-test was used to determine the students’ mastery learning after using the multimedia products which is developed.

The type of the data in this study is qualitative and quantitative. Data was analyzed by descriptive statistics. Qualitative data in the form of comments and suggestions for improvement of the products and materials experts and media experts described descriptively analyzed qualitatively to revise the products developed. Quantitative data is a data in the form of material expert assessment and media experts, the results of observation scores, and the results of pre-test and post-test. Quantitative data analysis is described as follows. first, quantitative data of material expert assessment scores and media experts, the results of observation scores, and the results of pre-test and post-test. Quantitative data analysis is described as follows. first, quantitative data of material expert assessment scores and media experts which is analyzed descriptively with the reference from conversion table which is adapted from Sukardjo (2005 : 53-54). It is present in the table 1 as follow:

<table>
<thead>
<tr>
<th>Value</th>
<th>Score Interval</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X &gt; 4.21</td>
<td>Excellent</td>
</tr>
<tr>
<td>B</td>
<td>3.40 ≤ X ≤ 4.21</td>
<td>Good</td>
</tr>
<tr>
<td>C</td>
<td>2.60 ≤ X ≤ 3.40</td>
<td>Enough</td>
</tr>
<tr>
<td>D</td>
<td>1.79 ≤ X ≤ 2.60</td>
<td>Not enough</td>
</tr>
<tr>
<td>E</td>
<td>X ≤ 1.79</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Note:
Ideal Maximum Score= 5 X i = ½(5+1) = 3
Ideal Minimum Score= 1/6(5-1) = 0.67
Second, quantitative data of product appeal observation results is converted into qualitative data based on the conversion value adapted from Sukardjo (2005: 53-54).

Table 2: Quantitative Data Conversion to Qualitative Data for Development of The Media

<table>
<thead>
<tr>
<th>Value</th>
<th>Score Interval</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X &gt; 12,806</td>
<td>Very Interesting</td>
</tr>
<tr>
<td>B</td>
<td>9,602 &lt; X ≤ 12,806</td>
<td>Interesting</td>
</tr>
<tr>
<td>C</td>
<td>6,398 &lt; X ≤ 9,602</td>
<td>Interesting enough</td>
</tr>
<tr>
<td>D</td>
<td>3,194 &lt; X ≤ 6,398</td>
<td>Less interesting</td>
</tr>
<tr>
<td>E</td>
<td>X ≤ 3,194</td>
<td>Very Uninteresting</td>
</tr>
</tbody>
</table>

Note:
Maximum Score = 1 x 16 = 16. \(X = \frac{1}{2}(16 + 0) = 8\)
Minimum Score = 0 x 16 = 0. \(SBi = \frac{1}{6}(16 - 0) = 2.67\)

Third, the data of pre-test score and post-test were analyzed by calculating the percentage of students who have obtained a score of 70 and change the percentage of mastery learning quantitative data into qualitative data.

Table 3: Learning Completeness Percentage Conversion to Qualitative Data

<table>
<thead>
<tr>
<th>Percentage (%)</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 ≤ X</td>
<td>Excellent</td>
</tr>
<tr>
<td>80 ≤ X &lt; 90</td>
<td>Very Good</td>
</tr>
<tr>
<td>70 ≤ X &lt; 80</td>
<td>Good</td>
</tr>
<tr>
<td>60 ≤ X &lt; 70</td>
<td>Less</td>
</tr>
<tr>
<td>X &lt; 60</td>
<td>Fair</td>
</tr>
</tbody>
</table>

6. RESULT AND DISCUSSION

The development of multimedia products in English vocabulary learning of fifth grade primary school begins with requirement analysis, instructional design development, product development, expert validation, product revisions, and then product trials. Based on the steps, it has been produced the research data which is become the results and discussion of the research, namely: the results of the data expert validation, observation data, and data from the pre-test and post-test. The research results will be discussed as follows.

a. Data of Expert Validation

Data of Expert validation is data obtained based on the expert material assessment and media experts through questionnaires. Material experts assess the content and the learning aspect, media experts assess the aspects of display and programming. After analysis, it is obtained that the average scores from material expert 3.75 and 3.71 for the aspect of learning. By using the score range of 1 to 5, the average assessment scores of material expert for content aspects and learning according to the conversion guidelines 5 scale is classified as a good criteria. Meanwhile, the average scores of media experts for display aspect 3.87 and programming aspects of 3.75. The average scores of media experts for display aspect and programming aspects classified as a good criteria. With the results above, it was concluded that multimedia learning English vocabulary fifth grade elementary feasible to use in learning both in content aspect and learning or aspects of the display and programming aspects for obtaining the scores average overall "B" or classified criteria "Good". This conclusion is accordance with the values specified in the feasibility of this research that when the material experts and media experts give a minimum scores "C" or by the criteria of "enough", the products which is developed are considered feasible to use in learning.
b. Data Observations

Based on the test results one by one, it is known that two of the three students show their interested on the multimedia which is developed in the criteria "very interesting", while a student show the attractiveness of the media on the criteria of "interesting". In a large group it is known that twelve students from twenty students were observed shows the attractiveness of the product on the criteria of "very interesting". While eight students show the attractiveness of the product in the criteria of "interesting". Attractiveness criteria is derived based on the conversion of quantitative data to qualitative data according to a scale of 5 Sukardjo (2005: 53-54).

With the results of the trial one-on-one and large group trials, we can conclude that the products which is developed "very interesting". This conclusion is gotten because more than half of the students indicated the attractiveness of products are on the criteria of "very interesting".

c. Data Results Pre-test and post-test

The purpose of pre-test and post-test is to obtain the students’ data score to determine the student’s mastery learning after using the product which is developed. Based on the minimum value of mastery learning standards that has been established is 70, it is known that in a large group test of 20 students, there are 19 students who complete in learning English vocabulary and only one student who did not complete learning English vocabulary. Thus, the percentage of mastery learning students is 19: 20 x 100% = 95%. Furthermore, the percentage of this completeness is converted into qualitative data to determine the criteria. By referring to the percentage conversion of learning mastery becomes qualitative data, it is known learning mastery learning is 95% the criteria is "Excellent". With these results, it can be concluded that English vocabulary learning multimedia in fifth grade elementary gives positive impact on students’ mastery learning and facilitate the students to learn English vocabulary.

7. CLOSING

The result of development research can be summarized as follows. First, the development of multimedia in English vocabulary learning in fifth grade elementary school has been done through six stages, namely: conducting requirement analysis, developing instructional design, developing learning multimedia product, validating the expert, doing a revision, and conducting trials. Secondly, if it seen from content aspect and learning aspect, the quality of multimedia which is developed the rated is "good" by the material expert. The "good" criteria is known through 5 scale score conversion table. The average of assessment score of material expert in content aspect is 3.75 and The average of assessment score of material expert in learning aspect is 3.71.

Third, if it seen from the display aspect and programming aspects, the quality of learning multimedia which is developed the rated is "good" by media experts. Media experts give an assessment in display aspet with average score 3.87 and programming aspects with an average score 3.75.

Fourth, based on the observation, it was concluded that the attractiveness of the product is "very interesting", because more than half of the students stated that the product is "very exciting". The attractiveness criteria is identified through conversion guideliness table of quantitative data to media’s fascination which is developed.

Fifth, the use of multimedia has a positive impact on students' mastery learning. From twenty students who had followed the trial in a large group of students there is one student who did not complete learning English vocabulary and 19 students (95%) completed the study with an average score of 16.25 or 81.25 from maximum score of 100. Mastery learning is classified as "Excellent".

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References


Online Manga and Anime in Promoting Language Learning and Literacy Practices

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Abstract: The field of language learning and literacy education is vast and ever expanding. New and hybrid literacies are always given birth to within and outside the field of education, in particular the Internet realm. With the reach of the online medium these new literacies has expanded for the consumption and production of people all over the world. More often than not, these forms of new literacies develop through the consumption and production of the many popular cultures within the Internet. Realizing the importance of these new literacy practices, a number of scholars have studied the impacts, roles, and potentials of these online popular cultures with relations to language learning and literacy education. Two of the more recent areas within the sphere of online popular culture being studied by literacy scholars are the consumption and dissemination of online manga and anime. This conceptual paper analyzes several key academic papers (i.e., commentaries, conceptual papers, research studies, etc.) published thus far on the use of online manga and anime in the field of language learning and literacy education. In doing so, the author discusses briefly the notions of New Literacies Studies and Multimodality in the use of online manga and anime in language learning and literacy education. The author also discusses a brief background of manga and anime; the roles and potentials of these genres as representation of universal culture and in promoting literate practices; and the issues or problems with online manga and anime in the field of language learning and literacy education. The author offers views, recommendations, and implications for the use of online manga and anime in the field of language learning and literacy research.

Keywords: Anime, English as a second language (ESL), language learning, literacy practices, manga, multimodality, New Literacies Studies.

1. Introduction

Manga and anime are forms of popular culture that derive from Japan, and they both are very popular, especially among young adults. The hype and enthusiasm for manga and anime is tremendous not just in Japan, but throughout the world (Black, 2005). In the past two decades, manga and anime have become major forces in global popular culture, resulting in which, they have begun to receive more scholarly attention mostly from the standpoint of popular culture study (Moist & Bartholomew, 2007). Scholarly works on manga and anime too has expanded beyond popular culture studies to include studies on education, most notably on language learning or literacy education (Bryce et al., 2008). This is due to the fact that many manga and anime enthusiasts create and maintain online fan sites, such as online discussion boards, forums, chat rooms, events, and many more online social networking activities in sharing their love for manga and anime (Black, 2005). All of these activities in fact require them to practice many literacy skills, such as reading, writing, listening, speaking, and learning about language, i.e., the English language, to interact with one another across the world.

Given the reach, popularity, and potential of online manga and anime in language learning and literacy education, the author reviewed a limited body of literature to learn from the discussions about and the studies on the use of manga and anime in the field of language learning and literacy education. Specifically, in this conceptual paper the author explains the notion of the universal culture that these two genres represent; the notions of New Literacies Studies and Multimodality in the use of manga and anime in language learning and literacy education; and (more importantly) the potentials and problems that have been identified with their use (or lack thereof) in the field of language and literacy education. Lastly, the author offers views, recommendations, and implications for the use of online manga and anime in the field of language learning and literacy education.
2. Manga and Anime Presenting Universal Culture and Promoting Literacy Practices

What was then a post-war development and served as a form of social entertainment conveying public service messages in Japan, manga and anime are now being marketed locally and internationally throughout the world by Japanese conglomerates as part of Japan’s most marketable product (Brienza, 2009). Slowly stemming from the shades of post-war themes, manga and anime grew more and more into various other themes portraying the Japanese and universal culture. The works of manga and anime became increasingly understood as a cultural flow from Japan to Asian countries, as well as to North American and European countries (Bryce et al, 2008). Because manga and anime mainly derive from Japan, they are quite distinct in features. For example, the manga and anime are usually drawn with flamboyant and unrealistic characteristics (i.e., extremely big eyes; slim and slender legs; colorful hair and extreme hair styles; and stylized costumes and appearances). Conversely, many manga and anime also have the portraits or animations of its characters somewhat simplistic, especially with regards to the facial expressions of their characters. However, regardless of the flamboyance or the simplicity of the drawings of the characters, the characters in manga and anime represent a complex array of physical and emotional states (Adams, 2001). Due to this fact, manga and anime interest both male and female audiences of all ages (including school children) from all over the world—and as such, they have become a worldwide cultural phenomenon (Drazen, 2002).

The notion of manga and anime as an international culture lies in the processes of translating, transcribing, subbing, dubbing, and redistributing the manga and anime, which are done by the fans of these genres for international audience. In doing so, these fans learn about both the Japanese culture and the English language (i.e., the language that online manga and anime consumers throughout the world interact most with). More importantly, they also engage in many language learning and literacy practices, such as reading about, commenting on, and editing/reviewing other fans’ insights on their favorite manga and anime (Black, 2009). From the view of language learning and literacy education these consumptions and (re)distributions of manga and anime genres (i.e., translating, transcribing, subbing, dubbing and redistributing the manga and anime) relied heavily on literacy practices and language competencies. Through the online medium, these fans—including English language learners—display their existing knowledge and linguistic competencies, such as writing poignant arguments, making critical reviews, reading and revising fan works, and many other literate practices. Through these linguistic activities, and other literate practices, such as creating and maintaining online fan sites and engaging in other online social networking activities (e.g., online discussion boards, forums, chat rooms, events, etc.), they also managed to “receive input from and/or interact with youths from across the globe, as they develop new linguistic and technical skills” (Black, 2009, p. 399).

3. New Literacies Studies and Multimodality

When talking about online popular culture and the use of technology in the language/literacy education field, the theories that are often associated with them are the notions of “New Literacy Studies” and “Multimodality.” The theory of New Literacy Studies posits to the need to broaden our understanding of literacy, in which it views the multitude of literacies as a range of social practices affected by social factors, such as socioeconomic status, race, or gender, and linked to broader social goals (Schwartz & Rubinstein-Avila, 2006). The studies on new literacies or multi-literacies focus on “a new stance that recognizes literate practices as dependent on the integration of visual (including both print and image), performed, oral/aural, and embodied forms of representation” (Moje, 2009, p. 352). Scholars and educators agree that online popular cultures, such as online manga and anime, fit into this notion of New Literacies Studies.

Meanwhile the notion of Multimodality refers to the use of “image plus language in increasingly complex ways” (Brown, 2006). The notion of multimodality also fits perfectly in the study of manga and anime in language learning and literacy education. The reason for this argument is that the manga readers and anime viewers, especially those who read and watch them online, are likely to attend to more graphical information on the computer screen as opposed to on the printed text. This is a drastic change from traditional reading that involves attending first to the written text, using pictures and
illustrations only as supplements to it (Schwartz & Rubinstein-Avila, 2006). Online manga and anime consumers are said to require “a complex visual reading on the part of the reader” (Adams, 1999, p. 71) especially if they are reading/watching online manga and anime—where there are multi-mode of medias are being projected onto the screen (i.e., texts, graphics, sounds, and animations).

Scholars of manga and anime in language learning and literacy education agree that online popular cultures, such as online manga and anime, fit into this notion of New Literacies Studies and with the idea of multimodality. Online manga and anime is different than other forms of popular culture is because these genres are the embodiment of hybrid texts. This is because manga readers and anime viewers, especially those who read and watch them online, are likely to attend to social and graphical information at the same hierarchical level as the printed text. These skills manga readers and anime viewers’ use may transfer well to other media, and vice versa (Schwartz & Rubinstein-Avila, 2006). More importantly it may also transfer to other purposes of reading/watching manga and anime—such as developing language/literacy competencies—instead of for mere entertainment purposes.

4. Manga and Anime in Language Learning and Literacy Education: The Potentials

A number of academic discussions about and studies on the use of online manga and anime have been done in the field of language learning and literacy education. Albeit little in number these academic papers report highly positive remarks for the use of manga and anime in language learning and literacy education.

The depth of issues and themes within manga and anime is also one of the virtues that researchers find in language learning and literacy education, especially in teaching and learning English literature. Seyfried (2008) contends that manga and anime need to be used in middle and high school because students (at this age) are ready to engage with intense emotions. The popular success of manga and anime works that delve into weightier human themes have proven as robust text genres, capable of faithfully representing a wide variety of material (Galman, 2009). One feature of the manga and anime that make them suitable for the teaching and learning of literacy, such as the English language (as the first or second language), is that these genres often allow for pages to be read and scenes to be viewed in a variety of ways, leaving them open to variable interpretations and multiple meanings within the overall narrative (Adams, 2001). Graphic novels, such as manga, have been found to be very effective in the teaching of English literature. In his study on the use of graphic novels by students, Seyfried (2008) found that by using graphic novels students are introduced to complicated philosophical concepts. With manga and graphic novels’ tone being quite distinct from prose fiction, the scope for telling stories of greater complexity and depth is increased (Seyfried, 2008). The students, as Seyfried (2008) observed, managed to identify and respond to the poignancy of the stories immediately where the characters, the themes, and the conclusions made sense.

In this regard, the manga and anime genres, as argued by Galman (2009), can be a unique, highly flexible tool for the examination, understanding and representation of cultural phenomena. Bryce and colleagues (2008) agree to this notion, where they believe the appreciation of manga and anime is highly interactive, involving high literate activities, such as meaning-making ‘off the page’ by circulating as part of social identities, practices, and exchanges generative of fan-based communities. Also, the manga and anime address themes, such as politics, daily life, and autobiography in creative (often sober) composition and style (Galman, 2009). In doing so, the manga and anime capture the multiplicity of voices and the historically- and socially-situated nature of stories by making use of “systems of symbols, texts, and images that allow multiple interpretations to occur simultaneously” (Galman, 2009, p. 200).

Manga and anime can also prove to be quite the motivating factor for students in language learning and literacy education. Seyfried (2008) argues graphic novels (i.e., manga) are more than just an elective or a book group. Manga seem to increase students’ confidence as readers and to develop their enjoyment of reading. Instead of heralding a regression from the art of the written word, studies are finding that manga and graphic novels are providing a new bridge to it (Black, 2009; Moje, 2009). Moreover, as the manga are usually a single tale told over a series of volumes, this encourages a commitment on the part of the reader to spend the time and effort to read a longer tale (Poitras, 2008). In another instance, Adams (2001), in his study on the use of manga among high school students, reports that the students reading skills are influenced and heightened due to reading manga.
Schwartz and Rubinstein-Avila (2006) also believe that manga and anime as a popular culture can serve as a tool for literacy development and critical inquiry, which is a very important skill in reading. The characteristics of manga and anime require multimodal reading skills and sharp critical inquiries. Hence, by using online manga and anime in a literacy classroom, students would be able to use the mechanics and multimodalities of these genres to learn “how to question their own pleasures” (Schwartz & Rubinstein-Avila, 2006, p. 47). Furthermore, manga and anime storylines not only afford readers a non-linear, rich imaginative read of the world, but also tap into an array of complexities in human experiences toward which young adults seem to feel great affinity (Schwartz & Rubinstein-Avila, 2006). They also argued that in order to incorporate the manga and anime into the literacy classroom, teachers need to be critical educators who can encourage youths’ reflexivity about their use of popular culture by selecting appropriate texts for the classroom to help students situate themselves in the world around them and underscore how power shapes the students’ “emotional, political, social, and material lives” (Schwartz & Rubinstein-Avila, 2006, p. 47).

Another aspect of manga and anime that is highly applauded by English education researchers is in terms of their use among learners of English as a second language (ESL). This is especially for international students (or even immigrant and refugee students) who are learning in English speaking countries, such as the United States of America, Canada, and the United Kingdom, among many others.

An important aspect in the consumption (i.e., reading and watching) of manga and anime contributing to their potential in teaching and learning of the English as a second language (ESL) is the translation of the Japanese manga and anime to the English-dubbed, English-subbed, or English-translated versions of the manga and anime disseminated in the online sphere for its larger universal audience. Black (2006) reports that due to the limited availability of English-language translations of Japanese texts, fans regularly produce their own translations of manga, by scanning them, overlaying English text, and then sharing them on the Web, as well as sharing their own English voice-dubbed versions of anime. The act of subbing, dubbing, or scanning the original manga and anime for redistribution is “an essential part of manga and anime fandom outside of Japan, not only because they provide new material for audiences, but because they are usually shared on websites with highly interactive virtual forums for fans” (Bryce et al., 2008). The act of subbing, dubbing, or translating the manga and anime enables and enhances meaning-making, in that fans, as translators, are in control of the meaning of the texts, and produce this meaning for the enjoyment of other fans.

In this sense, the use of online manga and anime in language learning and literacy education allows participants to create a performance “complete with pen-and-ink actors, sets, scripts, dialogue and the like to make a drama of their words” (Galman, 2009, p. 213) in that they would be allowed to explore (i.e., read) and produce (i.e., write) manga and anime interpretations of their own. Through intimate involvement with these texts, the fans engage in highly literate practices and language learning (such as, learning new vocabularies, reading critically, writing types of prose, and so on) as they re-form and re-generate these texts for others fans to create a deep attachment and build a sense of authorship over them (Bryce et al., 2008). Black (2009) supports this notion as she reports that reading/watching online manga and anime, and later producing their own manga/anime afford the students to index transcultural facets of their identities and develop meaningful cross-border relationships online. The students in her study also gained confidence and competence in a wide range of literate activities (such as reading, writing, revising, editing, etc.) and forms of representation, and the activities afforded them a “great deal of creative agency as they took up, reconstituted, and then redistributed cultural, linguistic, symbolic, and ideological material to a broad audience” (Black, 2009, p. 402).

Black (2009) also argues that the consumption and production of online manga and anime can provide a sense of relativity for foreign or international students in English-speaking countries in the way in which “technology-mediated, out-of-school literacy practices provide a counterbalance for ELL youth’s less successful attempts at using English in academic settings by allowing them to leverage a diversity of resources, including their Asian backgrounds, as they developed identities as powerful language users” (p. 420). Seyfried (2008) reiterates this notion by arguing that via manga and anime students could learn to deeply question how cultures are shown and seen, which is an important aspect of visual literacy, where they can serve to challenge readers’ observational skills while at the same time inform them. In this regard, manga and anime are also known to offer the language learning and literacy education classroom lessons on representation and identities. Schwartz and Rubinstein-Avila (2006) believes the manga and anime genres can act as entry points for critically examining societal disparities in the representation of gender and sexuality. Although manga and anime is by origin Japanese genre,
inequalities in the representation of males and females persist cross-culturally, and such issue is very important for young adult students in middle or high schools to learn about. Manga and anime can also provide a way for youths to negotiate alternative identities. By engaging with a wide range of manga and anime characters, dynamic plots, and storyboards, children and young adults make connections between these popular texts and their own life experiences (Schwartz & Rubinstein-Avila, 2006).

5. Manga and Anime in Language Learning and Literacy Education: The Problems

Even with the positive reports on the use of manga and anime in the field of language learning and literacy education, there are still concerns with the use of these genres in education. Given the popularity of online manga and anime among young adults, and their worldwide reach through the medium of the Internet, these genres have neither been explored in greater depth in the literacy research literature nor used widely in the classroom setting. So far, discussions regarding manga and anime are dominated by scholars in the field of cultural studies (Schwartz & Rubinstein-Avila, 2006). The academic establishment has yet to fully recognize these genres as legitimate formats for academic discourse. Galman (2009) argues that teachers and parents often undermine the ability to make meaning from the myriad of online popular culture texts to which young people are exposed. Online manga and anime, along with online comics and online games, are often perceived as contributing to students’ short attention spans, passivity, and lack of creativity, and as providing distractions from educational practices (Schwartz & Rubinstein-Avila, 2006). Hence, the discussions about and reports on use of manga and anime in the field of education is terribly scarce.

However, and more importantly, the little amount of studies on manga and anime that are readily available in the education field are not conclusive to the impacts and effects of online manga and anime in language learning and literacy education. Moje (2009) believes that the “research that exists on digital text use and its effect on achievement (as measured in tests and grades) is not extensive, and what does exist is inconclusive” (p. 357). Due to this inconclusiveness, Moist and Bartholomew (2007) calls for a nuanced and open critical approach that can deal with multiple perspectives and that builds connections between and among the positive and negative views of the use of manga and anime in language learning. There needs to be more research on manga and anime within the field of education. In this sense, Brown argues that studies on online popular culture, such as manga and anime, must not rely from other disciplines—but also contribute to them. Moje (2009) reiterates this notion by reporting that researchers need to conduct studies looking at new media literacies phenomena similar to those of other studies, with different groups, and then compare across studies (and academic fields) to generate richer and more complete theoretical insights.

Researchers need to maintain close and particular study at the “forefront of research in new media and literacies because the field shifts and changes rapidly” (Moje, 2009, p. 355). Moje (2009) believes that close and precise analyses must continue because there is still so much to learn about existing new media (such as the manga and anime), their uses, and their consequent literacy practices. In addition, Moje (2009) also strongly argues for researchers to study issues of access of new media and online popular culture in more depth because these studies can offer “comparative work across youth of different social class groups as a way of representing more fully the range and intensity of practices” (p. 356). From her analyses of studies done on new media, Moje (2009) contends that there are studies done on different age groups with different interests and experiences in new media, and how they engage in new media practices differently. However, she believes there needs to be “more attention to the range of practices of different groups might engage and to documenting practices across groups… taking into account findings across local and particular studies” (Moje, 2009, p. 356). In all, manga and anime studies need to include investigation of how these genres, through institutional recognition and incorporation as mass produced commodities, are granted wider social and cultural legitimacy and agency (Bryce et al., 2008).

6. Conclusion

The fact to the matter is manga and anime are very universal and they are very popular among young adults, children and even adults. More importantly, access to them can easily be sought through
the medium of the Internet, in which a lot of language learning and literate practices are taking place. All of the literacy elements one finds in manga and anime can draw readers of different ages and interests to a large number of works (Poitras, 2008). The use of manga and anime in language learning and literacy education is also very positively reviewed by literacy education scholars. Albeit small in number, a number of research have reported the success of using manga and anime in education for various purposes and for various intentions, such as, in teaching and learning of English literature, critical reading skills, creative writing skills, and so on. Some educators are also making use of manga and anime to develop students’ traditional writing skills; to encourage urban high school students’ development of reading and written communication skills; to narrate their own individual stories in a written composition; to instruct students on how to effectively convey multiple ideas in fewer words; and to develop students’ analytical and critical reading of visual texts (Schwartz & Rubinstein-Avila, 2006). And thus, these forms of online popular culture is not (and should not be) something foreign. As such, more progressive steps need to be taken by scholars, teachers, and educational institutions to acknowledge manga and anime in the world of education.

Due to the reach and access of the Internet, these genres have gained worldwide recognition due to their massive audience and their distribution in the world. The fans of manga and anime are far and wide and they range from various backgrounds, be it in terms of language, culture, age, or gender. Quite a number of studies have suggested positive educational outcomes from the use of manga and anime in English education. Yet, at the same time, these studies are still not enough to inform the scholars, teachers, and educational institutions of their true potentials and how they can actually be implemented in classroom settings. More studies need to be done to carefully learn about the use of online manga and anime in language learning and literacy education. In all, online manga and anime are here to stay, and the demand for manga and anime genres never decreased ever since the 1960s. Teachers, researchers and educational institutions need to not only recognize the appeals, potentials, and benefits of manga and anime—and take this opportunity to use employ manga and anime in language learning and literacy education—they also need to learn about the negative outcomes or possible issues that these genres have that can (and has thus far) hinder its use in language learning and literacy education. Therefore, we need to study these genres more closely, and discuss about the more openly, so that we would be more informed of them and that we can benefit more from them in language learning and literacy education.

References

Online Popular Culture in Language Learning: Reading and Writing Online Fanfiction

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Abstract: With the reach and accessibility that technology has provided, in particular the Internet, language learning has taken a different height. With the reach of the Internet worldwide, it is now very important to learn an international language, such as the English language, which the language most widely used in the Internet realm. Also, with the immense consumption and distribution of popular culture within the Internet, the concept of learning has evolved and given new meanings. One particular field that education researchers consider as a platform in language learning is the reading and writing of online fanfiction. This literature review examines a small number of research done so far on online fanfiction and its effects on learning the English language. In this review of studies of online fanfiction in language learning, the author discusses the participants of online fanfiction and the types of participation they engage in when reading or writing online fanfiction that thus lead to them learning about the English language.

Keywords: English language learners (ELL), English as a second language (ESL), language acquisition, language learning, online fanfiction.

1. Introduction

Fanfiction is fiction about characters or settings written by fans of the original work, rather than the original creators. It is the act of taking a story created by someone in the form of a book, television program or movie, and using it as a jumping-off point for new fiction within that world or across it. It is a channel for creative writing within a setting already defined by someone else; it is a way to share ideas with other fans, and means to explore facets of popular characters, themes, settings and plots (Black, 2005). The origins of fanfiction can be traced back to the 1930s pulp magazine Fanzines, and it enjoyed a surge in the late 1960s with the popularity of Star Trek (Thomas, 2006a). However, it is only in the 1990s that fanfiction was widely practiced by fans of television series, books, movies, and comic books. This was due to the surge of the Internet and the accessibility it offers to the fanfiction communities. Since then, online fanfiction has flourished and burst through the online scene especially with young adults and adolescents (Thomas, 2006b). In this sense, online fanfiction is “an element of popular culture that is ever growing in popularity as new technologies enable native and non-native English speaking fans from all over the globe to meet online to share, critique, and build upon each other’s fictions” (Black, 2005).

Online fanfiction has attracted quite a number of researchers in the fields of communication, arts, culture, and currently in the field of language learning. The reason that education researchers are interested in studying online fanfiction varies. Some researchers believe that online fanfiction is able to enhance and extend students’ literacy practices, such as reading and writing creatively and critically (Black, 2004, cited in Steinkuehler et al, 2005). Studying the writing of online fanfiction also allows researchers to learn how learning is accomplished in a participatory culture in which young people collectively pool their resources, i.e., sharing knowledge and getting latest information on their favourite stories (Alvermann, 2008). Through the study of students’ writing of online fanfiction, some researchers believe teachers will have a better understanding about student identity and self-representation. This is as because people who portray themselves in the virtual world as being someone other than the person that people in the real world perceive them to be, may have stories to tell that teachers, teacher educators, and researchers have not been privy to in the past (Alvermann, 2008).

The goal of this literature review is to examine the small number of studies done so far on online fanfiction in language learning. In particular, the review of the literature sought to answer these questions:
(1) Who are the people participating in reading and writing online fanfiction?; (2) How do they participate in reading and writing online fanfiction?; and (3) Is there any evidence on how reading and writing online fanfiction can enhance language learning? Through this literature review, the author also hopes that it would shed more light on the directions for research of online fanfiction in language learning.

2. Reviewing the Literature

This literature review reports on studies on the use of online fanfiction specifically in language learning (i.e., English language). Several major online research databases were researched in obtaining these studies (i.e., JSTOR, ProQuest, ScienceWiley, and SAGE). A few studies were also obtained from the Google Scholar search engine. The searches in all of these online databases were confined to the use of specific terms, such as “online fanfiction studies” or “reading and writing online fanfiction.” To explain, there were 743 studies found with the term “online fanfiction studies,” and 706 studies found in the electronic databases using the term “reading and writing online fanfiction.”

With the majority of these articles found in the Internet resources being commentaries, reviews, and essays on the use of online fanfiction, stringent selection of only empirical studies was done. Certain selection criteria were met to ensure that the studies were focused on the use of online fanfiction in language learning. First, the literature review focuses on only articles from peer-reviewed journals, such as Journal of Adolescent & Adult Literacy, E–Learning Journal, The Journal of American Culture, English in Education, The Reading Matrix, Australian Journal of Language and Literacy, Annual Review of Applied Linguistics, Educational Philosophy and Theory, and also e-books and periodicals, namely The International Handbook of Virtual Learning Environments and A New Literacies Sampler. Other studies done outside of this scope, that might employ different methods of research, different samples, and different types of online fanfiction activities were not reported. Second, the studies in this literature review were selected under the notions of language learning. Other studies that were done on writing online fanfiction, but within umbrellas of other fields, such as computer studies or communication studies were not included. Studies that suggested similar genres (i.e., fandom, fantasy writing), but did not use the terms mentioned previously, were excluded from the review. These steps were taken to minimize the review of irrelevant studies which might not be suitable for this literature review.

As many as 15 studies on the use of online fanfiction in learning the English language were found. All of the 15 studies on online fanfiction and language learning discuss about language education for both native and non-native speakers of the English language. They were published between the years 2002 to 2010. It must be noted that because of the nature of online fanfiction, the studies chosen tended to be more of the qualitative nature rather than quantitative. Fourteen of the studies applied qualitative research method. From these 14 studies, four are case studies; seven studies applied analysis of written discourse of the written response from the fanfiction writers and readers through the studies; and two studies are ethnographic studies. Only one study was conducted using a quantitative method, which is by using an online survey. All of the studies were done in the United States of America, except for one, which was conducted in Finland (Stepanova, 2007). All studies chosen were written in English language, regardless of whether they were written and published outside of English speaking countries.

3. Results and Findings

This literature review is presented in two main aspects, namely a) Participants in Online Fanfiction and Participation in Online Fanfiction. The reason this literature review is divided into these two parts is to show the participants in online fanfiction, (i.e., which range from children to young adults—most of which are within school-age limit) and to show the types of literacy practices (i.e., reading and writing activities) that they engage in the English language, that thus promote language learning for these online fanfiction enthusiasts, either formally or informally.

3.1.1 Participants: Readers and Writers of Online Fanfiction

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**Number of Participants.** The numbers of participants vary across studies due to the research designs and methods that the researchers use in studying them. There are nine studies (60%) that had fewer than ten participants (i.e., Black, 2005; Black, 2006; Chandler-Olcott & Mahar, 2003; Herzing, 2007; Mackey & MacClay, 2008; Thomas, 2006a; and Thomas, 2006b). These studies are mainly case studies (i.e., Black, 2006; Chandler-Olcott & Mahar, 2003; Thomas, 2006a; and Thomas, 2006b), studies that used analyses of written discourse (i.e., Kustritz, 2003; Mackey & MacClay, 2008; Mazar, 2006), and an ethnographic study (i.e., Black, 2005). There is one study that had below ten participants and used a mixed-method design of case studies and analysis of written texts (i.e., Herzing, 2005). From the nine studies, three studies had only one participant (i.e., Black, 2005; Black, 2006; Mackey & MacClay, 2008), three studies had two participants (i.e., Chandler-Olcott & Mahar, 2003; Thomas, 2006a; and Thomas, 2006b), one study had three participants (i.e., Herzing, 2005), and lastly one study had ten participants (i.e., Mazar, 2006). There are three studies (20%) that had more than ten participants (i.e., Allington, 2007; Bury, 2006; Kem, 2005). Two of these studies use analysis of written discourse (i.e., Allington, 2007; Bury, 2006) and the other one used an online survey (i.e., Kem, 2005). Allington (2007) has eleven participants, Bury (2006) has 22 participants, and Kem (2005) has 143 respondents to her online survey. There are three studies (20%) that did not mention the number of their participants (i.e., Black, 2007; Blasingame, 2002; Stepanova, 2007).

**Age Level.** The age levels of participants in the selected studies vary across studies as well. From the fifteen studies selected, there are six studies (40%) that had young adults as their participants (i.e., Black, 2005; Black, 2006; Thomas, 2006a; Thomas, 2006b; Allington, 2007; Stepanova, 2007). In contrast, there are only four studies (26.7%) that had adults as their participants (i.e., Chandler-Olcott & Mahar, 2003; Herzing, 2005; Kem, 2005; Bury, 2006). Unfortunately, there are five studies (33.3%) that failed to mention the specific age level of their participants (i.e., Blasingame, 2002; Kustritz, 2003; Mazar, 2006; Black, 2007; Mackey & MacClay, 2008). The appeal of the online fanfiction to the younger generation may have contributed to the number of the participants in the studies to be more likely of young adults. However, it is a nice surprise to find that one study reported a senior online fanfiction writer, which is the study by Herzing (2007) in which the author had three participants from three different age levels (i.e., an 11-year old girl, a 70-year old professor, and a 19-year old college student). From this review of studies, it can be reported that majority of the studies focused on young adults and children, i.e., those in school-age range.

**Nationalities of Participants.** From the selected fifteen studies, there are twelve studies (80%) that had participants from the United States of America (i.e., Blasingame, 2002; Chandler-Olcott & Mahar, 2003; Kustritz, 2003; Herzing, 2005; Kem, 2005; Bury, 2006; Mazar, 2006; Thomas, 2006a; Thomas, 2006b; Allington, 2007; Mackey & MacClay, 2008). Meanwhile, there are only two studies (13.3%) that had Asian participants, and only one study (6.7%) that had European participants, because it was conducted in Europe (i.e., Finland). Interestingly, the studies that had two Asian participants were also done in the United States of America, and the participants are actually immigrants from China who are studying in the United States, and they do not speak English as the first language. In this regard, majority of these studies was done to study native speakers’ use of online fanfiction in language learning, but, there are also studies that focused on the use of online fanfiction for non-native speakers in learning the English language.

### 3.1.2 Participation: Reading and Writing Online Fanfiction

**Online Fanfiction Web Domains.** The web domains that the participants use in reading, writing, or publishing their fanfiction works are almost equal in terms of public and private web domains. From the fifteen studies selected, seven studies (46.7%) reported on participants who publish their works on public fanfiction sites (i.e., Black, 2005; Black, 2006; Mazar, 2006; Thomas, 2006a; Thomas, 2006b; Black, 2007; Mackey & MacClay, 2008). Meanwhile, eight studies (53.3%) were done on participants who post their works in private group domains (i.e., Blasingame, 2002; Chandler-Olcott & Mahar, 2003; Kustritz, 2003; Herzing, 2005; Kem, 2005; Bury, 2006; Allington, 2007; Stepanova, 2007). The public fanfiction sites might allow participants to share or publish their works to more and different plethora of fanfiction enthusiasts, while the specific online fanfiction group sites allows only the members of those designated sites. Thus, both of these domains might have different appeals to researchers and online fanfiction readers/writers alike.


**Purposes for Online Fanfiction Participation.** All of the studies (100%) selected participants who are already engaged or involved in fanfiction prior to the studies. It is also reported that the participants in all of the studies are involved in the fanfiction as a leisure activity and not as a required activity from the schools, parents, or even the researchers themselves (i.e., Allington, 2007; Black, 2005; Black, 2006; Black, 2007; Blasingame, 2002; Bury, 2006; Herzing, 2005; Kem, 2005; Kustritz, 2003; Mackey & MacClay, 2008; Mazar, 2006; Thomas, 2006a; Thomas, 2006b; Stepanova, 2007). In this regard, it is quite interesting to learn that these participants engaged in online fanfiction voluntarily (i.e., without being instructed by teachers), and more importantly because they are engaging in the many language learning activities in reading or writing online fanfiction on their own, such as reading critically, giving feedback, and writing creatively and analytically, among others.

**Online Fanfiction Genres.** The genres that fanfiction writers read and write vary across the studies. In five out of fifteen studies (33.3%), the participants read and write their fanfiction works based on television series (i.e., Blasingame, 2002; Bury, 2006; Herzing, 2005; Kem, 2005; Mazar, 2006). In four studies (26.7%) the participants read and write fanfiction works based on ‘anime’ or Japanese animation (i.e., Black, 2005; Black, 2006; Black, 2007; Chandler-Olcott & Mahar, 2003). An equal number of the participants (26.7%) also read and write works based on books and novels (i.e., Allington, 2007; Stepanova, 2007; Thomas, 2006a; Thomas, 2006b). Two studies (13.3%) reported their participants used movies as the genre basis for their fanfiction activities (i.e., Kustritz, 2003; Mackey & MacClay, 2008). From the review, it is interesting to see that the participants in these studies chose a quite a range of online fanfiction genres to engage in (i.e., read, write, and publish). This implies that reading and writing online fanfiction vary across genres and appeal to many people with many different interests.

**Online Fanfiction Themes.** From the review of these studies, most of the participants focused on reading and writing online fanfiction based on the theme of science fiction. To illustrate, there are seven studies (46.7%) that reported participants’ reading and writing online fanfiction based on the theme of science fiction (i.e., Black, 2006; Black, 2007; Herzing, 2005; Kem, 2005; Mazar, 2006; Stepanova, 2007; Thomas, 2006a). Meanwhile, there are three studies (20%) that focused on the theme of adventure (i.e., Blasingame, 2002; Chandler-Olcott & Mahar, 2003; Mackey & MacClay, 2008). Three studies (20%) focused on the theme of eroticism (i.e., Allington, 2007; Bury, 2006; Kustritz, 2003); and two other studies (13.3%) focused on the theme of romance (i.e., Black, 2005; Thomas, 2006b). It can be posited that due to the nature of fanfiction (i.e., to re-create stories or characters from the original stories) the theme of science fiction seem best suit with what most of the studies focus on and the students’ interest—especially those who are in the school-age level. The theme of science fiction is also very appealing to these participants due to the creative space that the online fanfiction can afford to its enthusiasts in terms of reading, writing, and discussing about their favorite science fiction-themed stories.

**Intended Audience.** The majority of studies reported that the participants’ online fanfiction works is published for public viewing. Eight studies (53.3%) used public domains and the participants in these studies published their work for public viewing (i.e., Black, 2005; Black, 2006; Black, 2007; Mackey & MacClay, 2008; Mazar, 2006; Thomas, 2006a; Thomas, 2006b; Stepanova, 2007). Five studies (33.3%) focused on fanfiction on specific online societies that the participants intend to share works with (i.e., Blasingame, 2002; Bury, 2006; Herzing, 2005; Kem, 2005; Kustritz, 2003). Only two studies (13.3%) reported that the participants’ works of fanfiction are intended for close friends and peers that they virtually know (i.e., Allington, 2007; Chandler-Olcott & Mahar, 2003). The fact that majority of participants publicly publish their fanfiction works shows that these students are practicing very important literate practices that thus lead to language learning. To illustrate, these literate practices include thinking about the quality of their writing (such as grammar, sentence structures, etc.) as well as their literature knowledge (such as development of characters and plots, themes, and settings, etc.). They publishing their works publicly also indicate that they allow their peers to read and give them feedback on their works—in which both parties practice critical thinking and communication skills.

**Frequency of Reading and Writing Online Fanfiction.** Seven studies (46.7%) reported that participants read and write online fanfiction on daily bases (i.e., Black, 2007; Kem, 2005; Kustritz, 2003; Mazar, 2006; Stepanova, 2007; Thomas, 2006a; Thomas, 2006b). Meanwhile, five studies (33.3%) reported participants’ engagement with online fanfiction in various times (i.e., Black, 2005; Black, 2006; Bury, 2006; Blasingame, 2002; Herzing, 2005). Only one study (6.7%) focused on a weekly basis publishing of work (Mackey & MacClay, 2008). And, there are two studies (13.3 %) that did not mention of the frequency of reading and writing of the participants in their studies (i.e., Allington, 2007; Chandler-Olcott & Mahar, 2003). Even though many studies report varied time spent on the online activities.
fanfiction sites, it is understandable with the nature of the Internet and online fanfiction being accessible and available within the readers and writers’ own convenience. In this regard, the readers and writers of online fanfiction are motivated to read and write works of fanfiction in their own pace.

**Language in Reading and Writing Online Fanfiction.** All of the reading materials and writings produced by all of the participants were in the English language. However, there are twelve studies (80%) that reported on participants using only the English language as the medium of writing (i.e., Allington, 2007; Black, 2007; Blasingame, 2002; Chandler-Olcott, 2003; Herzing, 2005; Mahar, 2003; Kem, 2005; Kustritz, 2003; Mackey & MacClay, 2008; Mazar, 2006; Thomas, 2006a; Thomas, 2006b; Stepanova, 2007); whereas there are three studies (20%) that focused on participants’ use of ‘hybrid language,’ or the use of English language with particular Japanese or Chinese words. These participants used hybrid language in order to show authenticity of the works they are based upon. These hybrid language are derivative from the genre of the writing itself, such as Japanese Anime (i.e., Black, 2005; Black, 2006; Bury, 2006). Three of the studies that focus on the use of hybrid language (i.e., Black, 2005; Black, 2006; Bury, 2006) specify that the reason for their choice was due to nature of the participants being English language learners (ELL). However, and more importantly, due to the fact that most of the participants are school-age children and that they are learning English as either the first or second language, it is reported that they are engaging in many language learning elements when they read and write online fanfiction. These language learning elements are not limited to them only reading and writing works of fanfiction, but also discussing about their works in details (i.e., in chat forums)—in which this promotes communication skills—and they also engage in higher order thinking skills to which they analyse and give feedback on each other’s fanfiction works.

4. **Discussion and Conclusion**

From the studies reviewed, it is learned that online fanfiction has positive appeal and effect in students’ language learning (i.e., Black, 2007; Herzing, 2005; Thomas, 2006a; Thomas, 2006b). From these studies of the use of online fanfiction, researchers managed to investigate participants’ reading preferences, reading skills, writing skills, communication skills, and textual culture (i.e., Allington, 2007; Blasingame, 2002; Kustritz, 2003; Mazar, 2006). These studies also managed to provide evidence to the development of the literary skills and social practices in online fanfiction, such as English communication skills through chat forums and giving/receiving feedback on fanfiction works (i.e., Black, 2005; Black, 2006, Black, 2007; Bury, 2006; Chandler-Olcott & Mahar, 2003). In this sense, the researchers managed to find evidences of learning the English language taking place in online fanfiction where they managed to see the feedback and response of peers and audience of the online fanfiction and understanding of readers and author co-design the writing/reading space—all of which were done in the English language between native and non-native speakers of English (Black, 2005). Language development within the consumers of online fanfiction is also evident where studies found that fanfiction readers and writers develop codes and conventions to govern themselves (Mackey & MacClay, 2008) especially in the interrelations between fanfiction and its canonical source (Stepanova, 2007). Moreover, it is found that online fanfiction can enhance and extend students’ literacy practices (Steinkuehler et al., 2005); create participatory cultures where writers may pool resources—learn about the English language and culture (Alvermann, 2008); and also give teachers better evidence about student identity and self-representation, especially for international students who are learning English as a second language in English-speaking countries (Alvermann, 2008).

Albeit small in number, all 15 studies in this literature review espouse great support for online fanfiction, especially to the fact that online fanfiction can enhance students’ literacy practices and language learning skills. In all, online fanfiction has attracted many scholars and researchers to study it and its societies. However, as evident with only 15 studies that had been found so far in the language learning field, the focus on online fanfiction as a tool for language learning is still considered in its infant stage. Most of the studies reviewed have concentrated on small-scale level of its use in earning the English language as first or second language and language acquisition. Also, most of these studies have found great values in the use of online fanfiction in language learning—but have not really mentioned some of its possible limitations. Therefore it is worthwhile to see studies done in a larger, deeper, and more globalized (i.e., international) scale to see the possible successes or limitations of reading and writing online fanfiction in language learning.
References

Pedagogical Methods in Web-Based Language Teaching

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Abstract: This paper presents a research project that is being conducted at Dalarna University in Sweden. The aim is to study the following: 1) The quality of online language education compared with that of campus education, and 2) Advantages and disadvantages of online language education and how the disadvantages might be overcome. The project consists of two parts: pedagogical methods in online language education from the teachers’ point of view and from the students’ point of view. The first part was conducted in 2012 and various characteristics (benefits and difficulties) of online language education were identified. Flexibility and wider opportunities were general benefits, while lack of physical co-presence, difficulty in having lively debates/discussions, and high dropout rates were among the problems. The second part of the project (being conducted in 2014) aims to investigate how students experience online language learning. The goal is to explore alignments and misalignments between teachers’ perspectives and students’ perspectives, and to develop methods to enhance the quality of online education.

Keywords: pedagogical methods, synchronous online education, social aspects of online education

1. Introduction

In recent years, there has been an explosion in online education all over the world and Sweden is no exception. Over the past 10 years, the number of students enrolled in online courses has increased dramatically in Sweden. There were almost 80,500 students enrolled in online education in 2009, which is almost four times more than 10 years prior (Högskoleverket 2010, Statistiska Centralbyrån 2012). In this paper, we introduce a research project, “Pedagogical methods in web-based language teaching”, which was carried out at Dalarna University to examine the pedagogical implications of the development of online education.

The research project consists of two parts: "Pedagogical methods in web-based language teaching”, which took place in the year 2012 and which aimed to identify the various characteristics (benefits and difficulties) of online language teaching from the point of view of teachers; and “Pedagogical methods in web-based language teaching – Students’ point of view”, which is being conducted in 2014 and which aims to identify the benefits and difficulties of online language learning as perceived by students.

In particular, the research examines the extent to which teachers’ and students’ perspectives align or misalign, and identifies the possible reasons for divergent views. Based on the findings, the study also aims to identify potential change in pedagogical approaches which utilize technologies and which provide better support for students’ learning.

In this paper, we introduce the results of the first phase of the project and give an overview of the second part.
2. Background

2.1 Online education in Sweden

The number of students studying online at Swedish universities has risen dramatically since the beginning of the 2000s. One-third of students in higher education now engage in some form of online study compared with only 10 percent of students 10 years ago (Statistiska centralbyrån, 2012). Currently around 30 universities out of 50 in Sweden offer online courses.

At the same time, however, the Swedish government is worried that the pass rate for online courses is lower than that for courses on campus. Indeed, the average pass rate in higher education in Sweden was 81 percent in 2012, but for online (distance) education, it was only 55 percent (Statistiska centralbyrån, 2012). This has given rise to strong expressions of concern about the future of online education in the Swedish context (Budgetpropositionen, 2012). The present study project was initiated at Dalarna University in response to these concerns.

2.2 Online education in Dalarna University

Dalarna University has a strong focus on synchronous online education that includes real-time instruction. At present, 72 percent of all students at Dalarna University study online. The university started to invest in online education in 2002, and this investment made the university one of the fastest growing institutes of higher education in Sweden. In 2011, Dalarna University decided to aim to be a leader in Next Generation Learning (NGL) by 2015. The Bill & Melinda Gates Foundation (2010) defines NGL as follows: “the intelligent use of technology to develop innovative learning models and personalized educational pathways”. The vision of NGL at Dalarna University is to develop and renew educational settings with the support of technologies. In 2012 and 2014, various NGL projects were established to investigate ways of improving the educational situations.

With the focus on online courses and NGL projects, the language department at Dalarna University expanded rapidly. Presently, 12 languages are taught there: Arabic, Chinese, English, German, Italian, Japanese, Portuguese, Russian, Spanish, Swedish and Swedish as a Second Language. Most courses in these languages are taught online using a web-conference system called Adobe Connect and a learning management system called Fronter, both of which are continually being improved through discussions with teachers to ensure optimum pedagogical quality.

2.3 What are pedagogical methods?

Hampel and Stickler (2005) claim that online language teaching requires different skills than face-to-face language teaching and that online language tutors (teachers) must therefore be aware of the differences and focus on how to utilize technology to ensure the quality of online education. The rapid development of online education at Dalarna University has turned the development of new pedagogical methods into a major challenge for teachers. Our research group was therefore established to explore the challenges and potential pitfalls of pedagogical methods used with online language education and to develop a portfolio of ideas for enhancing the quality of our education.

For the purposes of this project, pedagogical methods are understood in broad terms to include whatever teachers do to ensure that students attain the relevant learning outcomes. This includes planning, designing and delivering courses, knowing students’ abilities, guiding students, implementing activities, designing ways to give feedback, etc.

3. Methodology

The research is based on a qualitative and quantitative methodology. It was conducted in 2012 and 2014 by six language teachers. A questionnaire and in-depth interviews were used to collect data from both teachers and students in the language department at Dalarna University. The analysis of data collected
in 2012 is complete, while the data from the second part will be fully analyzed in the autumn of 2014. Subsequently, a comparative analysis will focus on alignments and misalignments between teachers’ and students’ perspectives. Based on this, the project will develop methods for the enhancement of the quality of online education.

3.1 Participants

3.2 The first project

The participants of the first phase were teachers in the language department at Dalarna University. Around 90 teachers teach approximately 200 courses in the 12 languages taught there. For this project, we focused on those who teach languages at the lower (beginners’) levels. The main reason for this choice is that lower-level courses usually require more teacher support than higher-level courses. Thus, we hypothesized that both the benefits and the challenges with online teaching would be most visible in lower-level courses. Further, we estimated that these courses would have the most to gain from the development of new pedagogical methods suitable for online teaching environments.

After this preliminary selection, 23 teachers who teach lower-level courses focusing on oral and written proficiency were chosen to receive questionnaires. In addition, 11 teachers who specialized in pedagogy were chosen for in-depth interviews regardless of the courses they teach.

3.3 The second project

The participants in the second project are students in the language department at Dalarna University. In the beginning of May 2014, we sent out a questionnaire to around 2,300 students who were active in the online courses at that time. In addition, we aim to carry out 15 - 20 in-depth interviews with students for follow-up, in-depth interviews. These students will be chosen based on their language of study and level.

4. Findings

4.1 Findings from the first part - teachers’ point of view

There was significant variation in the types of activities, lessons, materials and assignments that teachers used for online courses. Even so, in terms of having students reach the learning outcomes, it was commonly asserted that there is little difference between online education and campus-based education. The three most frequently raised issues were the following:

• Issue 1. No physical co-presence
Several teachers noted that the lack of physical co-presence with students was a disadvantage with online education. Even though this issue was not viewed as fatal in terms of having students attain the learning outcomes, many teachers said that it is easier to hold conversations in classrooms, while online classes feel less like a personal encounter, have a colder atmosphere and are less dynamic.

Some teachers put in extra effort to resolve this issue. They strive to create a comfortable atmosphere and a group feeling. For example, they make it obligatory to use web cameras, or they ask students to evaluate their courses regularly so that they feel part of the course. Some teachers also spend extra time early in the courses to help students get to know each other. Finally, some teachers apply the concept of “personalization” (Kawaguchi, 2004), which aims to persuade students to express their own ideas, opinions, feelings and preferences.

• Issue 2. How can we have a “lively debate/discussions” in Adobe Connect?
The second issue was how to create “lively debate/discussions” in classes using the web-conference system Adobe Connect. Teachers noted, for example, that “interaction is less spontaneous due to slow
connections; you have to turn microphones on and off” and that “debate is artificial because you have to
talk in turns.”

On the other hand, some teachers did not find the technical issue insurmountable and were
dedicated to making the debates or discussions active. They experimented by selecting and combining
lessons: if students watch recorded seminars or if they hold discussions in the forum on LMS before the
seminars, they will be prepared for discussion and will be able to begin the seminars at a higher level of
engagement. Another idea was to divide students into smaller groups by using a tool in Adobe Connect,
the “breakout room”, so that students can use their microphones all the time instead of turning it on and
off.

- Issue 3. How can we decrease the dropout rates?
The third issue was the high dropout rates. Teachers noted that high dropout rates are a problem with
online education and as such they strive to decrease these. Our analysis indicates two possible factors
for such high rates. One is that there is a relationship between the dropout rates and the types of courses:
the dropout rates are higher if the course is independent (not part of a programme) or if it is a course for
complete beginners. The other factor relates to information. If information is difficult to find or
communication is unclear, students lose their motivation.

Additionally, it is important that a clear course description is available before students register. Often in beginners’ level courses, students’ expectations and teachers’ expectations differ; some
students have no academic intent, whereas teachers expect them to learn academic skills; therefore, it is
important it be specified in advance as to what is required of students if they are to complete the course
successfully.

4.2 Findings from the second part - students’ point of view

Since the second part is ongoing in 2014, the results will not be available until autumn 2014.
Considering the three challenges raised by teachers, our focus in making the questionnaire was on
learning about the social aspects of online education from the students’ point of view.

According to Moore’s (1993) transactional distance theory, “distance” is a psychological
distance and this transactional distance has to be minimized if learning by distance is to be maximized.
To maximize learning in online education, four types of interaction play important roles:
learner-instructor, learner-learner, learner-content, and learner-interface. The questionnaire was
constructed to investigate how students experience these four categorized interactions. The results will
be presented in the oral presentation at the conference.

5. Conclusion

Even though the project is yet to be completed, we have a number of preliminary findings. First, no
teacher mentioned that it is difficult to have students reach the learning outcomes in online courses.
Hrastinski (2013) also claims that there is no scientific evidence that online education is of lower quality
than campus-based education.

Secondly, no pedagogical method works perfectly for all students. That can be seen from the
various methods which are used by language teachers at Dalarna University. Ramsden (2003) claims
that a variety of methods should be used to ensure that all students, with their many learning
differences, are able to develop their knowledge and understanding. Accordingly, an important role for
the teacher is to carefully consider which tools and pedagogical methods will help individual students in
their learning.

In online education, students are spatially separate, and this can lead to feelings of isolation.
Thus, it is very important that teachers create a comfortable virtual-classroom atmosphere. This can be
achieved by using activities where students interact with each other outside class. For example,
“personalization” helps students to get to know each other, and “breakout rooms” rely on smaller
groups of collaborating students. Hrastinski (2013) also explains that problems exist with web-based
education since students can feel isolated: this might cause higher dropout rates compared with campus
education. He also argues that it is important that students get to know each other and feel comfortable with each other, especially in online learning situations.

Säljö (1992) argues that the interaction that occurs outside of class also plays an important role in learning. Learning occurs not only in the school environment, but also in all situations of interaction between people, such as at a dinner table, during coffee breaks, and so on. In the case of on-campus classes, it is easier for students to be connected and to continue their discussions after class. However, when it comes to online classes, students are disconnected when classes finish, which leads to fewer social contacts. Therefore, teachers of online courses have to try to create a sense of group during class so that students interact with each other spontaneously and enhance their learning even outside class.

The project Pedagogical methods in web-based language teaching: students’ point of view is being conducted in 2014, and as such the results of this part of our project will be presented at the conference. We can end by quoting Ramsden (2003), who reminds us that: “Good teaching involves striving continually to learn about students’ understanding and the effects of teaching on it.” Thus, education is not about one-way communication from teachers to students; rather, it is about teachers and students engaging in a process of mutual learning.

Acknowledgements

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Knowledge Features of Peer Response Process

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Abstract: There is no doubt that peer response facilitates learning. Yet, the knowledge features in the process of peer response still need further identification. In this paper, we identify four knowledge features of peer response process through the connections of early grades’ writing revision. In a suburban elementary school in northern Taiwan, a class of second grades participated the intervention of peer response on writing revision. Students reviewed the drafts from classmates and gave comments. After receiving comments from peers, writers went back revising the drafts. The result finds four knowledge features of peer response in early grades’ writing response process. Moreover, early grades benefit more from the the knowledge that they learn from the peer response process than the knowledge from peers’ explicit comments. Such findings have shed light on extending the knowledge of peer response process.

Keywords: knowledge features, peer response, writing revision

1. Introduction

Peer response have considered helpful to improve learning through social interaction with peers. Thus, the knowledge, experience, suggestions sharing from peers are reasonably considered as explicit knowledge resource. Mostly, research that adding the element of peer response attributed the improvement to peers’ tutoring, response, or supports. It is plausibly right, but seems to over-generalize the power of peers. Indeed, peers’ power is unneglected in the process of peer interaction, while it is risky to jump to the conclusion that peers’ support is the only reason of individual success in the peer interaction context.

Before distinguishing the reason of individual’s success in the peer response context, the knowledge features that channeling in such contexts should be identified ahead. How students gain knowledge or in what ways that facilitate their knowledge acquisition have been concerned and investigated for the researchers of education in decades. Specifically, some researchers (Dienes & Perner, 1999; Willingham & Goedert-Eschmann, 1999) considered that knowledge can be explicitly and implicitly learnt or gained. Generally, implicit learning refers to the learning that is inaccessible and non-verbalized performance, which can only be inferred through intact clues. Explicit learning, in contrast with implicit learning, refers to the learning that is accessible and could be verbalized by the participants, such as knowledge that can be recalled in the tests. Berry & Broadbent (1988) further indicated that implicit learning would happen when target knowledge was revealed without indication of the purposes. They conducted experiment to show the subjects certain learning materials and did not request them to learn or memorize it. Afterward, students were able to implicitly apply the learning on the following tasks. It can be considered that the appearance of learning materials can also cause implicit learning.

Since we bring the issue of social interaction in into implicit and explicit learning, the influence source of students’ knowledge learning needs to be further considered. Harris, Graham, and Mason’s (2006) study drew the conclusion that second grade students’ writing performance were able to improve under the condition of Self-Regulated Strategy Development (SRSD) and also benefit from peers’ support. In their study, students’ were explicitly instructed self-regulation strategies. Meanwhile, with the addition of peer support in this study brought “incremental” effect on students’ writing. Though they attributed students’ performance to self regulation and peers’ support, they failed to further investigate whether individual student’s writing increment was resulting from individual change on the peer-supported process. Thus, drawing from the knowledge sources and the knowledge representation, we identify four knowledge features to help clarify the knowledge in the peer response process.
In this study, we refer to the definition of previous studies about explicit and explicit knowledge. For the definition of explicit knowledge, we consider it is either visible or fit the purpose of telling; for the implicit knowledge it is considered as either not visible or the purpose of telling varies (referring to Berry & Broadbent, 1988).

- **Explicit peer knowledge (EPK):** Peers’ knowledge is visible and the receiver takes and applies it in the appropriate context.
- **Implicit peer knowledge (IPK):** Peers’ knowledge is visible but the it has been known by the receiver ahead. Hence, peers’ knowledge is no longer as a new but serves as a implicit reminder to the receiver.
- **Explicit self knowledge (ESK):** Personal knowledge is visible but it is the only connection of one’s own following performance.
- **Implicit self knowledge (ISK):** Personal knowledge is not visible but it affects one’s following performance. It is considered the influence of involving in the learning contexts.

To exam the potential of knowledge features in peer response process, we conduct the intervention of peer response on second grade students’ writing revision. The purpose of this study is to identify the knowledge features through connecting students’ writing revision with the receiving and giving comments. While in the nature of learning writing, we choose early grades for their possibility of developing the social support on achievement motivation and learning (Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003). Besides, in order to fulfill the peer response interaction of students’ writing revision, personal laptop connecting to the pre-designed writing system is necessary to facilitate comment exchanging and writing revision.

2. Method

2.1 Research context and procedure

The present study is conducted under an authentic classroom learning context. It is an ongoing project conducting on eight classes of second grades in a suburban elementary school in northern Taiwan. Each class contains about 30 students. All participants are native speaker of Chinese. Students in the school began using tablet PC with keyboard to do web-based learning tasks (Chinese typing tasks, math learning tasks, reading and writing tasks) from the first grade. In the regular writing task, students need to generate four stories or essays on the Drawing and Writing System (Liao & Chan, 2013) during the semester. To facilitate the process of peer response on writing, a sub-system was built upon the Drawing and Writing System, named Writing Response System (Wang, Hsieh, Liao, Shih, & Chan, 2013). Each students can give and receive comments online through this system. When revising the writing, the system allows students to check peer comments at the same time. Last, this system also provides scaffolding prompts for students to use during giving feedback.

In this paper we selected a class of second grades to give intervention of peer response on writing draft for initial trial of peer response on writing revision; we intend to see how students initial response on such activity. To help students effectively improve writing, the intervention of peer response for writing revision was arranged in December, 2012. The intervention were processed without interfering regular writing tasks. During the intervention, Students had already completed two drafts, which titled *A day of Father* and *Firework*. Before the intervention, a ten minutes mini-lesson was provided to teach students the essentials of group peer response (how to review and give comments on peers’ drafts, the appropriate matters to orally share thoughts with group members, and how to revise personal draft according to receiving comments) for writing revision.

Before the intervention, students were arranged as groups (about four student as a group). The intervention was firstly reviewing drafts of group members and giving comments through Writing Response System. Second, writers in each group orally read the self-draft and group members gave comments typing on the Writing Response System. After all group members shared and received comments face-to-face, each student went back to the draft and revise it.
2.2 Data collection and analysis

In order to investigate the knowledge features through the connection between writing revision and the comments, all revision logs and giving and receiving comments are saved on the Writing Response System. For the revision logs, writers are able to click “save” after they change any part of the draft. It represents as different versions of change. For example, when one student have three revision logs, it means the student have three saved versions of the the same writing. Hence, the researchers are able to identified the parts that are revised and further connecting to comments.

For the comments, students also save them as soon as they type it on the comment section. After the intervention, the researchers examine each comment and exclude invalid ones (no words and symbols, duplicated comments, making jokes or misusing the prompts). On the other hand, since the comments from the second grade students were simply containing one unit idea, unlike older students that may carry more than one unit idea in the comments (Cho & Cho, 2011), each comment is taken as carrying one unit in this study. Further, data is organized by each student. That is, each writer have the records of giving comments, receiving comments, and revision logs. After data is organized, the researchers triangulate revision logs with comments.

The procedure of connecting the revision logs and comments is described as follows. First, every revision logs and comments are listed in accordance with each student. Second, revision parts are identified from each log. Third, writers’ giving and receiving comments are reviewed one by one to see whether they could connect to the revision logs. According our hypothesis of knowledge features, we identify the connecting types revision and comments enclosed with description of each types in Table 1:

<table>
<thead>
<tr>
<th>Type of Knowledge</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
</table>
| **Explicit peer knowledge: Connecting to receiving comments** | When revision connects to the comments explicitly receiving from peers (peers’ knowledge about writing) suggesting to the revision contents. | [Original version] 小明趕快打電話請消防車請消防趕緊到現場。 Ming urgently called the firefighter and asked them to come right away.
[Revision log] 小明趕快打電話請消防車請消防趕緊到現場 消防隊很緊張的說：別急！別急！我會盡快趕到的。 Ming urgently called 119 to the firefighter and asked them to come right away. The firefighter said nervously: Clam down, I will get there as soon as possible.
[Receiving comments] 我覺得你對角色的描述可以再仔細點像是，字太少了。 I suggest you describe the characters precisely, you need to write more. |
| **Implicit peer knowledge: Connecting to Giving & Receiving comments** | When the revision connects to the comments both given from the writer to group member and those from peers suggesting to the revision contents. Both giving and receiving comments can be connected to the revision logs. It fits the feature of implicit peer knowledge because the receiving comments (peer knowledge) is similar with the giving comments (the writer has known). Thus, the receiving comments serve as an implicit reminder the the writer of what s/he has known about writing. | [Original version] 爸爸教導我的方式比較嚴格,他常說:「事不過三」，事情犯錯只有兩次機會，第三次犯錯就會處罰。
The way Dad teaches me was strict. He often say “three and out.” You are only allowed to make the same mistake twice and will get punished in the third time.
[Revision log] 爸爸教導我的方式比較嚴格,他常說:「事不過三」，事情犯錯只有兩次機會，第三次犯錯就會處罰，所以我最多只有做到第二次。
The way Dad teaches me was strict. He often say “three and out.” You are only allowed to make the same mistake twice and will get punished in the third time, so I only make it twice.
[Giving comments] 我覺得你故事內容太少，像第三篇和第四篇，內容只有一點點。 I think the content of your story is insufficient. For example, the content of the third and fourth paragraph are few.
[Receiving comments] 字太少。
The amount of words is insufficient. |
| **Explicit self knowledge: Connecting to giving comments** | When revision connects to the comments (background or learnt knowledge about writing) explicitly giving to group members but afterward the comments as a reminder to affect his/her |
own revision (one’s own performance). The comments may not be directly suggesting the same but similar problems.

Example

<table>
<thead>
<tr>
<th>[Original version] 他趕快拿起手機，打 119 告訴消防隊。</th>
</tr>
</thead>
<tbody>
<tr>
<td>He grabbed the phone and called the firefighter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[Revised log] 小新 趕快拿起手機，打 119 告訴消防隊</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sin grabbed the phone and called the firefighter.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[Giving comments] 你的字有些打錯了。</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some words in your draft are wrong.</td>
</tr>
</tbody>
</table>

Implicit self knowledge: Connecting to neither comments

When the revision (one’s following performance) connects to neither giving nor receiving comments. It is inferred that the writer is influenced by the peer response process.

3. Results and Discussion

The purpose of this study is to identify the knowledge features of peer response process in the context of early grades writing revision. For connecting the revision and the comments, the analysis results is focused on the students who revised the writing drafts.

3.1 Overview of the results

In order to identify peer response knowledge features through observing how early grades act in peer response on writing revision, we observed their overall performance on two interventions. Specifically, we found that the revision results from each students can be separated as revising and not revising the drafts. Hence, we divided the data into the groups of Revising Writing Students (RWS) and No-Revising Writing Students (NRWS) (Table 2). On the other hand, among all the comments collecting from students, we found that some comments were meaningless or duplicated. Hence, we decided to exclude from the analysis. For the invalid comments, one may consider the possibilities of including them into analysis. The reason we did not adapt them in the analysis was for their complexity.

As mentioned in the section of data collection, the invalid comments were those with no words and symbols, duplicated comments, jokes or misusing the prompts. The cause of giving these kinds of comments might be because students’ personality, the misuse of the system, or classroom cultures. Although we agree that these factors may influence peer response activities, such extension is beyond our purpose of investigation of peer response on writing revision. Thus, we only analyzed the comments that referring to the writings. Further, the comments divided as comments giving to peers and receiving from peers. Generally, students performance on the second intervention improved (see Table 2).

Table 2: Descriptive information of all students data.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Interventions</th>
<th>A day of Father</th>
<th>Firework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comments</td>
<td>N (%)</td>
<td>M</td>
</tr>
<tr>
<td>RWS</td>
<td>Number of RWS</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Original giving comments</td>
<td>86 (100%)</td>
<td>6.14</td>
</tr>
<tr>
<td></td>
<td>Filtered giving comments</td>
<td>34 (40%)</td>
<td>2.31</td>
</tr>
<tr>
<td></td>
<td>Original receiving comments</td>
<td>79 (100%)</td>
<td>5.64</td>
</tr>
<tr>
<td></td>
<td>Filtered receiving comments</td>
<td>34 (43%)</td>
<td>2.43</td>
</tr>
<tr>
<td>NRWS</td>
<td>Number of NRWS</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Original giving comments</td>
<td>92 (100%)</td>
<td>7.08</td>
</tr>
<tr>
<td></td>
<td>Filtered giving comments</td>
<td>43 (46%)</td>
<td>6.14</td>
</tr>
<tr>
<td></td>
<td>Original receiving comments</td>
<td>99 (100%)</td>
<td>7.62</td>
</tr>
<tr>
<td></td>
<td>Filtered receiving comments</td>
<td>36 (36%)</td>
<td>5.14</td>
</tr>
</tbody>
</table>

*Revising writing students (RWS), students who revised their drafts; No-Revising writing student(NRWS), students who did not revise their drafts.
3.2 Knowledge features: the connection between revision and comments

Since we intend to investigate the connection between revision and comments to identify the knowledge features of peer response, the data of revision logs is firstly presented (see Table 3). Overall, the amount of revision logs improves more than two times (from 44 to 106 logs). For the revised words, it varies from 408 to 1049 words. Both the giving and receiving comments increased two times as well.

We connects the revision logs and all comments. The results of connection of writing revision with comments are presented in Table 4. As mentioned previously, the connection between revision and comments are coded as four knowledge features. For EPK, which affected writers’ revision from peers’ suggestions, the percentage decreased from 40 to 19. For IPK, it affected writers’ revision from both prior knowledge and peers’ suggestions, is increased from 16 percent to 23 percent. For ESK, which affected students’ revision from prior revision knowledge, there were only 7 percent of the logs in the first peer intervention, while it increased to 26 percent in the second intervention. It shows that writers’ giving comments became more relevant to the self-draft revision. For ISK, it reveals 37 percent at the first writing while slightly decreased in the second writing (32 percent).

First, EPK in the data is considered that students’ revision benefit explicitly from peers’ knowledge though peers’ comments. The percentage of revisions connecting to peers’ comments reduces in the second peer response activity. It may imply that the writer learn the revision knowledge from peers’ comments at the first draft revision but it reduces for the limits of early grade peers’ revision knowledge. Hence, writers benefit less from peers because peers can give few newer knowledge in the second draft resulting from their insufficient revision knowledge.

Second, IPK is shown that the revision increasingly connected in the second draft. It can be interpreted that writers have gained more knowledge about writing from first intervention. In the second intervention, writers have obtained more knowledge than in the first intervention. Thus, in the process of checking peer comments, the peer-provided writing revision knowledge serves as a reminder to the writers of what they have learned. Consequently, writers’ prior and obtained knowledge are retrieved and implicitly guiding them to revise their writings.

Third, ESK is referred that students’ revision benefit explicitly from writer’s own knowledge though the comments this writer gave to others. The comments that connecting to comments the writers giving to peers increase in the second draft revision. It may be interrelated as the writers acquire the revision knowledge through the peer response process and apply the skills in the second draft revision.

Fourth, ISK considered that students’ revision benefit implicitly from the peer response on writing revision itself. From the analysis result, the revision connecting to no comments decrease only 5%, indicating that about one third of revisions were not referred to author’s and peers’ comments. It can be implied that early grades perform similar trend of writing revision preference to older students.

<table>
<thead>
<tr>
<th>Writing topics</th>
<th>A day of Father</th>
<th>Firework</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td>Revision logs</td>
<td>44</td>
<td>3.14</td>
</tr>
<tr>
<td>Revised words</td>
<td>408</td>
<td>29.14</td>
</tr>
</tbody>
</table>

Table 3: Descriptive information of the writing draft revision.

Table 4: The connecting of writing revision with comments.

<table>
<thead>
<tr>
<th>Writing topics (interventions)</th>
<th>Connecting to Receiving comments (EPK)</th>
<th>Connecting to Giving &amp; Receiving comments (IPK)</th>
<th>Connecting to Giving comments (ESK)</th>
<th>Connecting to no Comments (ISK)</th>
<th>Revision logs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>A day of my dad</td>
<td>17 (40%)</td>
<td>7 (16%)</td>
<td>3 (7%)</td>
<td>16 (37%)</td>
<td>43 (100%)</td>
</tr>
<tr>
<td>Firework</td>
<td>20 (19%)</td>
<td>24 (23%)</td>
<td>27 (26%)</td>
<td>34 (32%)</td>
<td>105 (100%)</td>
</tr>
</tbody>
</table>

777
In summary, the peer response process helps early grade students develop implicit self knowledge. In addition, students benefit from the implicit self knowledge more than the explicit peer knowledge. Peers’ comments play a weaker role because of the lack of newer knowledge that early grades can provide in the second peer response intervention. Last, peers’ comments implicitly stimulate writers’ knowledge through the whole peer response process. Writing revision through the influence of prior knowledge and peer knowledge enables students to retrieve the revision knowledge and practicing it on the drafts.

3.3 Conclusion

The purpose of this study is to identify the knowledge features in the process of peer response. Specifically, we design a context of early grades’ writing revision facilitated by peer response. From the result of data analysis and discussion, we identify four knowledge features from the connection between writing revision and peer comments, which are explicit peer knowledge (EPK), implicit peer knowledge (IPK), explicit self knowledge (ESK), and implicit self knowledge (ISK). It is concluded that early grades learned writing revision knowledge from the provided scaffold prompts, peers’ comments, and the peer response process. Moreover, early grade students benefits more from the peer response process (ISK) than from peers’ comments (EPK). Thus, for early grades, giving comments may play a major role of constructing knowledge through interaction while the comment itself may only play a minor role in the revision performance.

The identification of the knowledge features of peer response process makes it clear that students in the peer response process benefit from different knowledge sources. Researchers of related studies should start concerning the knowledge channeling in the process of peer response and clarify how students get improved by. Eventually, the picture of knowledge features in peer response learning can be completed.

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Real-time Feedback Systems in a Foreign Language Teaching: A Case of Presentation Course

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Abstract: This paper is concerned with a new type of real-time feedback system in a classroom based on the text data collected from the audience. After reviewing two traditional approaches to real-time feedback; the Clicker Approach and the Forum Approach, it will be suggested that either of them is insufficient as a tool to motivate the learners in a case of presentation course. Instead, we propose two systems on the basis of text-mining technique to compensate for these insufficiencies. The first is a “Keyword and Frequency” system and the other is “Mind-mapping” system. In this paper, we describe the details of the systems. By being presented the keywords and data on frequency, the presenters can easily understand about the general feedback tendencies. In addition, the mind-map picture gives the presenters the opportunities of promoting a new awareness, various kinds of discoveries, and a deeper reflection about their works. Totally, our system can be incorporated into Learning Management System (LMS), and it has a large potential for further use in a distant learning environment to capture an overall reaction from the audience all over the world.

Keywords: real-time feedback, text-mining, keyword and frequency, mind-mapping, presentation course

1. Introduction

This paper is concerned with the implementation of text-based feedback system with focus on foreign language presentation course. The importance of feedback for learning has been mentioned in the literature, emphasizing its role in fostering meaningful interaction between students and instructional materials (Buchanan, 2000), its contribution to students’ development and retention (Yorke, 2001) and students’ participation and engagement in the class tasks and activities (Ono, Ishihara and Yamashiro, 2014).

This paper starts the review of the traditional approach to real-time feedback. There have been two proposals made in the literature: the “Clicker” approach and the “Forum” Approach. The former approach usually makes use of multiple-choice questions created by the instructor beforehand. In this sense, we can call it the “Quantitative” Approach. On the other hand, the latter utilizes the “Bulletin-board” usually incorporated into Learning Management System (LMS). The raters just make free comments on the board and it is reflected on the screen in the classroom. We can call this the “Qualitative” or “Bulletin Board” Approach in this sense. In a Moodle, a typical example of familiar Learning Management Systems, the bulletin-board mode, named “Forum”, takes this role under the class management. As will be reviewed in the following section, these two traditional approaches are very popular. However, we would like to mention that either of them is insufficient in terms of presenters’ motivation. Instead, we propose our text-mining approach to desired purposes.

2. Backgrounds
2.1 The Role of Real-time Feedback

It is commonly agreed that learning is more effective when interaction occurs between learners. (Hentea, Shea, & Pennington, 2003; Schmieder, 2008). In a case of foreign language teaching, making presentation provides students with an opportunity to reconsider their approaches to critical thinking, problem solving, collaborative learning, speaking, and writing. Instant feedback activities that engage the audience are one method of encouraging active learning for both presenters and their audience. By providing feedback immediately after a student completes his or her presentation, the experience is more authentic, and occurs precisely when he or she is the most receptive to criticism, coupled with the excitement of the reaction (Ono, Ishihara & Yamashiro, 2014: p.2). Improving the quality of instant feedback activities can motivate students to become more involved in the learning process. Various kinds of tools have been introduced in order to guarantee the “interactivity” and “quality” of the feedback in a large-size classroom. In the following subsection, we review two of such major tools for real-time feedback.

2.2 Traditional Approaches

There are two major approaches to real-time feedback system. One approach is “Quantitative” and the other is “Qualitative”. In the first approach, the instructor or lecturer prepares a multiple-choice question that is displayed in the classroom. Students answer or click the number of their choice. Then, the statistic results (number, average, etc.) were shown on the screen. The second type is the use of bulletin-board. Recently, the use of Social Network Service (SNS) has been reported.

2.2.1 Quantitative Approach: Use of “Clicker”

A commonly-used device for this approach is “Clicker”. It can be referred to as “Audience-Response Analyzer (ARA). This system involves multiple-choice questions created by the instructor beforehand. Even in non-wired classroom, the recent analyzer makes it possible to receive the responses from the audience by setting up teacher’s PC, response receiver, and a lot of response senders. The picture of “Clicker”, a sender and a receiver, is given in Figure 1, and that of its output of the system is given in Figure 2.

![Figure 1. Picture of “Clicker”](image1)

![Figure 2. Picture of Output](image2)

Although Clicker has been spread world-wide including Japanese classrooms, this approach tends to be based on highly quantitative output and its descriptive statistics. The question items for instant feedback tend to be multiple-choice questions, voting questions among, say, five candidates, or consciousness surveys on the five-point Likert scale. In the case of feedback of presentation course, clicker questions tend to be 5-point Likert questions like “Pronunciation is good”, or “Visuals are helpful” and so on. The more deeply we need to know the results on the basis of assessment rubrics, the
more detailed question items we need to ask the audience. And students have to answer all of them in, say, three minutes.

2.2.2 Comment List Approach: Use of Bulletin Board

Here comes the role of open-ended questionnaire. Instead of showing the statistic ratings of each question items, the presenter can recognize what the audience felt about their presentation directly from their feedback comments. Actually, this is an easy way to do, because the common SNS or bulletin-boards installed in LMS are now available to instructors given net environment in the classroom. Since the concept of “Social Interaction” and the social learning approach has been widely spread, the use of SNS (Twitter, Facebook, Line, and so on) has become much easier for everybody including students and instructors. When we consider the effective feedback activity in a presentation course, it is reasonable to use this technology as an instant feedback tool (Hasegawa, Yasui & Yamaguchi, 2013).

However, if this is a large class, say, more than 100 students are enrolled in the course, using a large classrooms, the presenter have to take a look at 100 feedback comments one by one. It might be difficult to understand the general tendency about the presentation from a list of raw feedback comments. Uncontrolled feedback comments might appear on the screen. The instructor must give sufficient instruction on what kinds of comments should (not) be posted for feedback activity. The use of LMS can remove this risk, but it is not certain that the system can draw only acceptable text data from the audience. The point here is that we need to provide a certain level of analysis so that the whole comments can encourage the presenter to try for the next trial.

2.3 Proposal: Text-mining Approach

On the face with insufficiencies of two traditional real-time feedback approaches, we would like to propose an alternative feedback system on the basis of text-mining technology. The basic concepts of our proposal are given below:

--- Real-time process of analyzing collected raw text data
--- Produce tendency graphs according to keywords or categories prepared by the instructor previously
--- The use of natural language processing (text-mining) method to pick up keywords
--- Reference to the original feedback comments by presenters

The first trial is for producing graphs of results on frequency of the given keywords. The schematic outline of the proposed system is described in Figure 3 below:

The analyzer has to recognize the dependency relations between words. CaboCha is a high-level free Japanese syntactic parser, which enables us to analyze syntactic dependency of Japanese sentences. CaboCha was employed in our system for analyzing dependency relation of a sentence. The process is driven with proc_open() function and the package is installed in the activity module of our Learning Management System (LMS); Moodle. This is shown in Figure 4.

Usually text-mining is conducted offline; a certain amount of time is spent after the class to analyze and derive important clusters of meaningful concepts from text data through statistical processes. Since our system is constructed with the intention that the feedback is given soon after the input by audience is finished. Therefore, we just concentrated on the use of descriptive aspects of statistics as an output of the system. The system is implemented in Moodle as one activity session. This makes the students work on this activity even outside the classroom. The students can refer to their results of text-mining since it is stored in DB. In addition, they can make reference to original text data the audience gave to the DB to make their points clearer.
2.3.1 Keyword and Frequency Approach

In order to process text data for our purpose, the author created a dictionary for evaluation. For selecting lexical items, the actual text data collected when the pilot study was carried out previously were used. 50 students participated and made open-ended comments on each of ten presentations. After analyzing these data by CaboCha, around 410 lexical items were selected and two kinds of properties were given to each item. These properties were (i) properties on impression and (ii) properties of semantic categories like “design/layout”, “interest”, “English”, “pronunciation”, “citation”, and “others”. The file of our evaluation dictionary is shown in Figure 5. All the audience have to do is to write down the picture of input box. The presenter was given the feedback output soon after the presentation is finished, as shown in Figure 6, where the results are shown in a graphs and a radar chart. The result of Figure 6 includes the ratio of positive/negative words appearances and number of frequency of each semantic category. In addition to this, the student (presenter) can make reference to the original text data by clicking the key words. This is shown in Figure 7.
2.3.2 Mind-mapping Approach

The proposed keyword and frequency approach has an advantage of providing information of what kinds of keyword audience picked up about the presentation, not just as an average score of a question item. However, the output results of this system have no consideration on the relatedness among keywords or frequency of co-occurrence between words; our system just shows a frequency of the keywords themselves. The collected text data should be shown so that the concepts or ideas of the audience can be visualize schematically as a mind map. This might help instructors to have an insight into the audience’s conceptual models from plain text comments.

According to Flanagan, Yin, Inokuchi & Hirokawa (2013), drawing a mind map can be thought of as a problem of searching one-by-one for related keywords, starting in the center with the keyword or image that is central to the concept. The related keywords or images are reiterated and expand in a radial pattern, linking back to the central concept through contextual relations. Our mind map of a word was constructed through the depth-first-search procedure. Given a word w, firstly we obtain the set of documents that contain the word w. Then, we extract the characteristic words of the documents set according to the relevance degree. In the present paper, we adopted the SMART measure by Salton & McGill (1983). The top K words are selected according to the measure. Each word u_i in the feature words is then used to "AND" search by "w u_i," and a new node with the label "u_i" is linked from the root whose label is "w". We repeat this process until the depth reaches the fixed parameter D. Note that a word is checked once it is used in search keyword. Thus, a word appears only once, and the graph becomes as a tree. A sample map is shown in Figure 8 below.

Figure 8. A Sample of Mind Map

In this sample, a presenter is interested in how his “slide”, which is located at the center of the map, appeared in the feedback from the audience. The mind map output shows that the word “slide” is related to three words; “letters”, “easy to see”, and “speak”. The last keyword “speak” might be a new finding for learners, since “slide” has a relationship with “speaking”. This might be a striking suggestion...
because they might not be aware that the speed of speech helps the audience have a focus on their slide. Conversely, the new finding might include that speaking too fast does not allow the audience to see their slides comfortably. This type of analysis is not brought about from the simple list of free comments unless several participants directly made comments this way.

3. Concluding Remarks

Since this new mind map feedback has an advantage over simple list of comments as in Forum approach or frequency based text mining feedback, the next step of this study is to examine how effectively the mind map can be integrated into the course or instructional design. Other issues involve the development of dictionary according to the topic to be presented. More and more keywords related to the topic of presentation must be stored in the dictionary. A longitudinal data collection will tell us the process of change of concepts behind the feedback. Topic effects and proficiency effects might be visualized in the form of change of structures in the mind maps. We would like to research on these issues one by one in the near future.

Acknowledgements

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References

Sauce for the Goose?
Testing SVECTAT in Japan and Taiwan

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Abstract: Shared Virtual Environment Complementing Task Achievement Training (SVECTAT) uses authentic task-based communication in Second Life to provide practicum for classroom language learning. SVECTAT has been found effective and efficient in improving functional ability and confidence. Here we present the results of parallel experimental sessions using SVECTAT for English language learners in two different countries, Japan and Taiwan, with the purpose of identifying differences in results and possible reasons for them. We find implications for broader use of this type of language learning method.

Keywords: English as a foreign language, task-based language learning, technology enhanced language learning, Second Life, shared virtual environment

1. Introduction

Language learning and language teaching face a daunting gap between classroom activities and independent authentic communications. Compounding this, in most cases, learners are not located in a target language environment. Another profound challenge lies in the limited resources available in formal teaching situations, particularly those of time and individual attention.

Task-based language learning (Prabhu, 1987) focuses on authentic language use in the achievement of meaningful tasks. It targets self-efficacy taking place in context (Lan, 2014; Lan et al. 2013). This method is found to be effective in developing fluency and confidence (Ellis, 2003). Shared Virtual Environment Complementing Task Achievement Training (SVECTAT) implements task-based language learning using the online service Second Life as a medium for learners to apply classroom learning to independent communications in an authentic target-language community based on achievement of meaningful tasks (Elwell et al., 2009).

In multiple tests, carrying out communication tasks through the medium of Second Life has lowered the learner's sense of stress and risk, while increasing the learning value of the instructional time (Cook et al., 2010). Those tests, however, were conducted by a single research team at a single institution, and indicated a need for broader testing to evaluate the value of the method (Elwell et al., 2010).

Here we report on a test of SVECTAT for task-based situated language learning. We conducted parallel experimental sessions in two different countries and teams with graduate students learning English as a foreign language, with the purpose of identifying differences in results and possible reasons for them.

This paper will summarize the method and previous results of SVECTAT. Next, we will present the methodology and results of our parallel experimental sessions in Japan and Taiwan. Then, we will discuss differences in the performance of the different groups of subjects, and possible reasons for them. Finally, we give a conclusion and references.
2. The SVECTAT Method

The SVECTAT method consists of classroom exercises based on achievement of meaningful communication tasks, complemented by authentic achievement of those tasks using the medium of the shared virtual environment of Second Life to meet and interact with actual users of English in an open social situation.

Instructors or facilitators first introduce the exercise to a group of learners and present a list of communication tasks, such as “Make a date or appointment” or “Pass a message”. They then model sample tasks, and both language content and strategies for achieving them.

Next, the learners practice the sample tasks with the instructors or facilitators, and with each other. Scaffolding changes form and even strengthens, but prepares learners for when it is removed.

Finally, the learners enter a public social venue in Second Life and interact with users to achieve tasks from the list provided. These Second Life user-interlocutors are logged in from all over the world, but use English as a medium of communication. This practicum provides authentic interactions for task achievement.

In three tests at a graduate institute in Japan, SVECTAT was found to achieve the same level of language learning in half the instructional time compared with individual role-play of the same tasks with a model speaker (Cook et al., 2010; Elwell et al., 2009). Learners mentioned in particular the value of being able to take what they had learned in the classroom and immediately apply it in the “real world” (See Figure 1). This was observed as a “flow” experience (Czikszentmihalyi, 1990).

![Figure 1. SVECTAT session in physical and virtual environments](image)

3. Experiment

We held two parallel experimental sessions, one in Japan and one in Taiwan, in April 2014. Twelve master's students participated in each location, all learners of English as a foreign language. The Japan session was led by model speakers experienced with SVECTAT; the Taiwan facilitators was led by researchers and graduate students, including a model speaker, all new to using SVECTAT.

Each three-hour session began with an introduction of the learning activity by the instructors or facilitators and individual completion of two evaluation instruments by the subjects as a pre-test. One instrument was a multiple-choice test consisting of 10 communication tasks, for each of which the learners selected the most appropriate of 3 phrases to use. The other was a self-assessment on the same tasks, for each of which the learners selected “NA – not able”, “Competent”, “Confident”, or “Independent” as their own ability to achieve the task in an authentic interaction.

After the pre-tests, each session conducted modeling and practice with the full group of 12 learners. Instructors or facilitators modeled sample tasks and provided guidance and support for the learners to practice task achievement with one another.

Half of the total time of the sessions was used for the main exercise. Control groups continued to practice and discuss task achievement while leaving the classroom one by one to attempt individual task achievement with a model speaker. Experimental groups spent 1/3 of this time period becoming familiar with the use of Second Life, and the remainder engaging in interactions with other users to attempt task achievement.
The final period of the sessions focused on individual completion of the two evaluation instruments (multiple-choice and self-assessment) as a post-test. The arrangement and flow of the experimental sessions is shown in Table 1.

Table 1: Experimental Flow

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
</tr>
</thead>
</table>
| 30 min | - introduction  
|        |   - pre-tests  
|        |   - demonstration                                                      |
|        |   [all subjects]                                                           |
| 30 min | Guided and supported group task achievement practice                        |
|        |   [all subjects]                                                           |
| 90 min | - Individual task achievement training  
|        |   (face to face with model speaker)                                       |
|        |   [control group]                                                          |
|        | - Individual task achievement training (in Second Life with authentic speakers) |
|        |   [experimental group]                                                     |
| 30 min | - post-tests  
|        |   - debriefing  
|        |   - discussion                                                            |
|        |   [all subjects]                                                           |

4. Results and Analysis

As seen in Table 2 below, all groups showed measurable improvement in performance on the multiple-choice test after the learning exercise. This experiment did not target what part of this improvement resulted from, e.g., classroom practice, individual task-achievement, or the opportunity for reflection in taking the test a second time.

Table 2: Multiple-Choice Test Scores

<table>
<thead>
<tr>
<th></th>
<th>Test Scores</th>
<th>Japan</th>
<th>Taiwan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Classroom</td>
<td>Second Life</td>
</tr>
<tr>
<td>Pre-test</td>
<td>4.8</td>
<td>5.67</td>
<td>8.5</td>
</tr>
<tr>
<td>Post-test</td>
<td>6.67</td>
<td>6.3</td>
<td>9.67</td>
</tr>
<tr>
<td>Post - Pre</td>
<td>1.87</td>
<td>0.63</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Of note is that both Taiwan groups scored significantly higher on both the pre-test and the post-test than the Japan groups. This raises the question of how much room for improvement existed, and therefore whether the method has similar value for learners of different prior ability. It also raises the question of whether learners' abilities and attitudes vary based on factors such as features of culture and education systems in difference countries.

As seen in Table 3, below, both groups in Japan showed clear improvement on the self-assessment after the learning exercise, while the groups in Taiwan showed minimal positive improvement (control) or actual negative improvement (experimental). This divergence will receive attention in the Discussion section.

Table 3: Self-Assessment Results

<table>
<thead>
<tr>
<th></th>
<th>Communication Task Achievement</th>
<th>Self-Assessment</th>
<th>Japan</th>
<th>Taiwan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>Classroom</td>
<td>Second Life</td>
<td>Classroom</td>
</tr>
<tr>
<td>Pre-test</td>
<td>0.92</td>
<td>0.92</td>
<td>1.78</td>
<td>1.98</td>
</tr>
<tr>
<td>Post-test</td>
<td>1.46</td>
<td>1.63</td>
<td>1.87</td>
<td>1.75</td>
</tr>
<tr>
<td>Post - Pre</td>
<td>0.54</td>
<td>0.71</td>
<td>0.09</td>
<td>-0.23</td>
</tr>
</tbody>
</table>
Note: We did not receive two participants’ self-assessments from the Taiwan experimental group; data for that group is therefore based on four participants.

5. Discussion

5.1 Bases and Questions for Discussion

We base our discussion on the logistics of the sessions, the results of the multiple-choice tests and self-assessments, and the observations and opinions of the instructors and facilitators, as obtained through interviews using a questionnaire. From these, we derived three differences requiring attention:

• Subjects in Taiwan scored and self-assessed higher than subjects in Japan
• Subjects in Japan but not in Taiwan showed significant self-assessed improvement
• Conduct of the two sessions had differences related to instructor and facilitator experience

Note: instructors and facilitators are identified by location and number, e.g., JI2 and TF4.

5.2 Country-based Gap in English Ability

Subjects in Taiwan scored and self-assessed higher than subjects in Japan. In the multiple-choice pre-test, the subjects in Japan had a mean score of 5.23, while those in Taiwan had a mean score of 7.75, a difference of 2.52 out of 10; in the multiple-choice post-test, the difference was 2.6. In the self-assessments, the differences were 0.96 in the pre-test, and 0.27 in the post-test.

While both country groups were composed of master's students, the institution in Japan was a science and technology research institute, while the one in Taiwan was an education university. In Japan, students in science and mathematics tracks and schools at the high school level and beyond receive significantly less English instruction than those studying humanities. This tends to compound the already serious gap between Japan and other Asian countries in performance on tests such as TOEFL and the SAT. It seems likely that this contributed to the country-based gap in scores and self-assessments.

All the facilitators in the Taiwan session agreed with the reported observation that the communication tasks were too easy for the students there, “because they were all master's students”. This observation demonstrates the country-based language ability gap strongly. Whereas all the subjects in our study volunteered for a learning exercise held in English, a majority of master's students at the institution in Japan where the session was held would be unable to participate at all, for lack of ability to function in an English-language classroom, let alone an authentic English-language communication environment.

5.3 Country-based Gap in Improvement

Subjects in Japan showed significantly more improvement in their self-assessed ability to achieve the listed communication tasks after the learning exercise than subjects in Taiwan. The mean improvement of the subjects in Japan (control and experimental) was 0.625, whereas that of the subjects in Taiwan was actually negative, at -0.07. This result in particular raises questions about what sorts of learners and learning situations are suitable for SVECTAT.

The students in the control group in Taiwan were nervous about interacting with the facilitators (based on TF3’s report). Conversely, in the Taiwan experimental group, students showed low anxiety and high enjoyment of participating in the activities (TF5, TF1, TF6). Overall, the instructors found the students in Japan to be nervous about communicating in English, though much moreso face to face than using the shared virtual environment.

The experimental sessions, as in previous SVECTAT tests, worked better for introverts. As one of the facilitators mentioned, “Let’s say for introverts, they don’t want to show their faces. They don’t want to talk face-to-face. They can do the typing.” Since science and technology students in Japan are widely seen to tend to be introverts, this may also be relevant to the country-based gap in results.
5.4 Instructor and Facilitator Experience-based Differences

Much of the feedback and opinion in the instructor and facilitator interviews was related to the gap in experience with the SVECTAT method between the instructors in Japan and the facilitators in Taiwan, and its possible influence on the learning experience and the experimental session results.

The instructors in Japan, experienced English language teachers, had conducted exercises and controlled experimental sessions with SVECTAT three times before. In addition, they were the original developers of the method. Conversely, the facilitators in Taiwan, researchers and graduate students, had received explanations and guidance related to SVECTAT and to the planned experimental session only in two online meetings, and had not themselves experienced a SVECTAT activity either as facilitator or learner.

All the facilitators in the Taiwan control group (TF2, TF3, TF4) consistently reported that the participants were nervous during the activities because they (the participants) were not clear about what they needed to do and what their final goal in the activity was. These facilitators, and those in the experimental group (TF5, TF1, TF6) all further reported that they themselves did not have a clear picture of their role and tasks before conducting the experiment. In the Japan session, the instructors and participants found no such difficulties.

6. Conclusion

We tested the feasibility, applicability, and effectiveness of Shared Virtual Environment Complementing Task Achievement Training (SVECTAT) for task-based language learning. We conducted parallel experimental sessions in two different countries, carried out by different teams of facilitators, with graduate students learning English as a foreign language.

We found significant differences in the results in the two sessions. Subjects in Taiwan scored and self-assessed higher than subjects in Japan, showing a gap in English language education and cultural attitudes toward English language learning. Subjects in Japan but not in Taiwan showed significant self-assessed improvement, likely due to differences in the conduct of the two sessions related to instructor and facilitator experience, and simply to greater room for improvement.

This test has shown us that, while the SVECTAT method can be effectively tested and used in different countries and with different teams of facilitators, care and affordances are required to ensure results that will justify its use, both for learners and for facilitators. Specifically, attention must be paid to the starting abilities of the intended learners, and both written materials and experiential training need to be provided to prospective facilitators; further, assessment and feedback methods must include open-ended, reflective instruments for both learners and facilitators. We consider these to be indications for future work in research and development of SVECTAT.

References


Situational Sets Effect on Role-Play Game Supported English for Specific Purposes Vocabulary Acquisition

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Abstract: The purpose of this study is to examine the effectiveness of using the Facebook online game, ChefVille, as an English learning tool to facilitate English for Specific Purpose (ESP) vocabulary acquisition. In addition, students’ learning motivation toward the Facebook online game, ChefVille was studied. This game used situational sets in a role-play game (RPG) learning environment as ways of bringing words together so that students related words to the central concept. The instruments used include a questionnaire, and two vocabulary tests. The results confirmed that incorporating an online RPG-based method facilitated students’ ESP vocabulary acquisition. It was also revealed that an online RPG-based learning method is effective in promoting motivation and changing attitudes toward vocabulary learning. The results derived from the experiment led to the conclusion that applying an online RPG-based learning strategy into ESP vocabulary learning can yield positive learning effect for the learners.

Keywords: RPG, situational sets, ESP, vocabulary acquisition

1. Introduction

With the rapid development of business communities around the world, English language skills have been considered an important tool needed to compete in the global economy. One of the goals of foreign language education identified by the Ministry of Education of Taiwan for vocational educational programs is to provide students with the foreign language ability and advanced professional knowledge necessary to succeed in the job market. This development trend has caused ESP instruction to be more greatly emphasized for the last few years at vocational schools in Taiwan (Johns & Dudley-Evans, 1991).

ESP is well known as a learner-centered and content-based approach to teaching English as a foreign language, which meets the needs of learners who need to learn English for use in their specific fields, such as business, science, technology, or academic learning. However, there are some problems in the development of ESP courses in Taiwan. Porcaro (2001) indicated that authentic materials and specific knowledge were not provided in ESP courses. Considering the problems for ESP development in Taiwan mentioned above, the aim of this study is first, to check if students acquire more ESP vocabulary using situational sets in an RPG learning environment, and second, to seek students’ motivation toward the Facebook online game “ChefVille” as a tool to facilitate ESP vocabulary learning.
2. Related Work

By definition, English for Specific Purpose (ESP) is designed to meet specific needs of the learner (Dudley-Evans & St. John, 1998). ESP has some distinctive features with special attention to authenticity. Nunan and Miller (1995) define authentic materials as those which “were not created or edited expressly for language learners. Authentic materials illustrate how English is used naturally by native speakers.” One of the most challenging tasks constantly facing ESP teachers is how to bring authentic materials into the classroom. With the advantage of RPG-based learning environment, students are able to develop their own strategies for dealing with real language and stimulate their motivation to learn.

Role-play games (RPGs), in which students are encouraged to come across different authentic materials related to their study subject, are highly graphical 2D or 3D video games played online allowing individuals to interact not only with the gaming software but also with the avatars of other players through their self-created digital avatars (Steinkuehler, 2003). Moreover, virtual learning in RPG environment provides a space for constructive learning and immerses learners in a meaningful communication simulated to authentic practices (Chuang, Chang & Chen, 2014). It is recommended that RPG be implemented in the contexts where students need to learn the knowledge and skills of English and practice them in authentic ways as they provide active interactions and collaborations among learners as well as address cognitive issues and foster active learning (Yip & Kwan, 2006).

Moreover, situational sets in vocabulary learning require the use of “general concepts” to bring together the specifics. It refers to the “cohesive chains” of relationships between words in a discourse. The technique stresses the need for using the context or situation in which words appear as an organizing principle. For example, cluster words such as reservation, grilled salmon, salad dressing, appetite, and slow service are revolved around the central concept customer in restaurant setting. The examples of situational sets were presented as the following (as shown in Figure 1).

![Figure 1. Examples for situational sets](image_url)
3. Method

3.1 Research Design

The study was designed to answer the two following research questions: 1) Do students actually acquire more ESP vocabulary using situational sets in an RPG learning environment? and 2) What are students’ motivation toward the Facebook online game “ChefVille” as a tool to facilitate ESP vocabulary learning? We investigated the first question by constructing and administering a special self-designed vocabulary test. Secondly, we investigated the second question via framing and implementing a self-designed questionnaire.

3.2 Procedure and Instruments

“ChefVille” is one of the English version games from Facebook. There were forty participants (experimental group) were assigned to engage in the learning environment compared to the other forty participants (traditional teacher-directed instruction) . This game is not embedded in the learning class; it means that participants would utilize the game, as an English learning tool anytime and anywhere they like. The experimental sequence of the study took approximately twenty hours spread over one month. The game is regarded as participants’ additional English learning tool; therefore, they are expected to learn with no stress and are supposed to learn autonomously and acquire vocabulary spontaneously. Therefore, there is no strict time restriction; participants can decide how many days and for how long they would like to spend their time playing the game, but they must use it at least four hours a week. “ChefVille” lets users run their own restaurant, do the shopping, enquiry and purchase, make dishes, and serve the dishes to build up their unique restaurants (as shown in Figure 2). In addition, it may be a feasibly situated learning environment for problems solving and tasks completion in order to achieve a goal (as shown in Figure 3)

![Figure 2. Authentic task-based scenario in the game](image1)

![Figure 3. Goal-based interaction for situated learning in the game](image2)

The instruments used consisted of two sections. Section 1 aimed to estimate participants’ current English vocabulary size in order to do a comparison with the vocabulary acquisition
achievement after the learning environment. The vocabulary tests were administered as the pre-test, the immediate post-test, and the delayed post-test. The content of testing items were the same, but the sequence of the items was dissimilar. Example for the testing items was presented as bellow (as shown in Table 1).

The participants had 50 minutes to finish the vocabulary test divided into two parts. The first part of the test was a recognition test containing ten items of matching English vocabulary with Chinese in a traditional vocabulary recognition test form. The second part of the test contained ten questions testing sentence comprehension and vocabulary, which are randomly chosen from ChefVille’s daily questions. The test design aimed to provide learners with the closest simulation of the game’s format with the concern of decreasing test-takers’ anxiety in order to assess their authentic performance. The total points of the test were 50 each.

Table 1: Example for vocabulary test items.

<table>
<thead>
<tr>
<th>Part 1: Matching English vocabulary with Chinese</th>
<th>Part 2: Please choose the right answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples:</td>
<td>Examples:</td>
</tr>
<tr>
<td>1. ( ) (1)vegetarian</td>
<td>1. ( ) Which of the following is not found in basic mayonnaise?</td>
</tr>
<tr>
<td>( ) (2)bartender</td>
<td>a) egg b) oil c) milk</td>
</tr>
<tr>
<td>( ) (3)appetite</td>
<td>2. ( ) Which ingredient is not present in Pat’s inventory?</td>
</tr>
<tr>
<td>( ) (4)chef</td>
<td>a) wheat bread b)lettuce c) milk</td>
</tr>
<tr>
<td>( ) (5)cashier</td>
<td></td>
</tr>
<tr>
<td>(A)主廚 (B)食慾；胃口 (C)出納（員） (D)素食者；素食的 (E)酒保</td>
<td></td>
</tr>
<tr>
<td>Total: 50 points (5 points for each item)</td>
<td>Total: 50 points (5 points for each item)</td>
</tr>
</tbody>
</table>

In Section 2, in an attempt to obtain participants’ motivation and vocabulary learning effectiveness, the questionnaire distributed to explore the participants’ learning motivation of toward the Facebook online game “ChefVille” as a vocabulary learning tool over an extended period of time, revealing their learning situation as well as personally significant transformations.

The questionnaire classifies the features of motivation toward the Facebook online game “ChefVille” as a tool to facilitate ESP vocabulary learning into the following five factors: personal interest, external expectations, learning achievement, social contact and social stimulation.

4. Discussion and Conclusion

This study investigated the effectiveness of using the Facebook online game, ChefVille, as a learning tool to facilitate ESP vocabulary acquisition, and students’ motivation of English learning using ChefVille. In accordance with the results and discussion, several major conclusions are made.
First of all, the results indicated that situational sets with RPG support are beneficial to students’ ESP vocabulary acquisition. According to the finding of the study, the experimental group (RPG-enhanced instruction) reached higher scores than the control group (teacher-directed instruction). Much difference was found in two vocabulary test scores across the two learning conditions. In terms of motivation, the students scored highest on the scale of “Social Stimulation” followed by the “Social Contact”, indicating that the sociocultural approaches linking to students’ daily life experiences might be able to foster students’ motivation toward situational sets with RPG support learning. The use of online RPG-based learning environment can promote students’ willingness to learn. Most of the students possess good attitudes and hold positive perspectives toward online RPG-based English learning. Some of the limitations of this study could serve as future directions for conducting related studies. The newly developed Motivation toward RPG Situational Sets Learning Survey should be validated with a larger sample across different grade-levels and with a more rigorous method such as confirmatory factor analysis. Moreover, as previously mentioned, researchers can adopt qualitative or mixed methodologies to explore students’ motivation toward situational sets with RPG support learning from different perspectives and identify additional scales.
References


Understanding English Language Learners’ Experiences and Perceptions of Mobile Assisted Vocabulary Learning

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Abstract: Grounded in the field of Mobile Assisted Language Learning (MALL), this study aimed to explore students’ experiences of using a vocabulary learning application as a self-study tool, and to understand their perceptions of the related learning experiences. With Taiwanese English-as-a-Foreign-Language (EFL) learners from a university as participants, the students were instructed to use the application via smartphones or tablet PCs to learn vocabulary for five weeks. During the intervention, the collected data included: self-reported learning logs, technology acceptance questionnaires, and semi-structured individual interviews. The findings revealed that both the tablet PC and the smartphone groups favored the vocabulary learning application, and their user experiences as well as perceptions yielded similar positive results, regardless of the mobile device utilized.

Keywords: Mobile Assisted Language Learning (MALL), vocabulary learning, English as a Foreign Language (EFL)

1. Introduction

Mobile Assisted Language Learning (MALL) is developing into a sub-field of Computer Assisted Language Learning (CALL), given the growing use of mobile technology for learning in recent years. Pioneering MALL studies focus on the use of early mobile devices, such as PDAs (Song & Fox, 2008) and cell phones (Stockwell, 2007; 2008; 2010). In these studies, mobile devices are criticized for posing challenges to learning because “inherent in the portability of mobile media are reduced screen sizes, limited audiovisual quality, virtual keyboarding and one-finger data entry, and limited power” (Chinnery, 2006, p. 13).

Current mobile devices, however, have much larger screens with higher resolutions, and allow learners to download a variety of applications (or apps) that can be used to learn foreign languages. With the rise of mobile technological advancement, limited research has been conducted on the potential of the latest mobile devices for language learning. The main type of mobile learning apps used in early MALL studies center on vocabulary learning, since these are easily accessible to most researchers who do not have the resources or abilities required to develop custom apps to suit their specific purposes. Due to limitations and earlier criticisms of previous MALL research, this study aims to fill the research gap by comparing the effectiveness of the new generation of mobile devices (i.e., smartphones and tablet PCs) on language learning. Therefore, this study also focuses on the use of a vocabulary learning app, EngKing, that is available for free via smartphones or tablet PCs.

The purpose of the study was to explore English-as-a-foreign-language (EFL) learners’ experiences and perceptions of mobile assisted vocabulary learning. The following three research questions are addressed in this study: 1) What were the students’ experiences of using the vocabulary learning app as a self-study tool, in terms of frequency of use and difficulty of use? 2) What were the
students’ perceptions of using the vocabulary learning app as a self-study tool, in terms of perceived usefulness, perceived ease-of-use, and behavioral intention of use? 3) Did the students’ overall experiences and perceptions of mobile assisted vocabulary learning vary significantly based on different mobile devices used?

2. Methodology

2.1 Setting

The research site was a content-based course at a public university in Taiwan. The title of the course is Science, Technology, and Society (STS), and its main objectives were to enhance students’ understanding of STS issues in society, while improving their English vocabulary knowledge. In total, 50 students enrolled in this two-credit course in 2012, but only 21 students were recruited to voluntarily participate in the study, due to the limited availability of the mobile devices required for this study. All the participants were English majors with an intermediate proficiency level. The participants were aged from 20 to 21 years old, and only four of them were male.

2.2 Participants

Based on the purpose of the study, the participants were further divided into two groups: a tablet PC group and a smartphone group. The mobile devices for the tablet PC group were loaned to the 12 participants by the instructor for the duration of the study. By contrast, the 9 participants in the smartphone group used their own devices.

2.3 Research Design

Since EngKing is primarily designed to assist English language learners in vocabulary drills and practice, this app was deemed appropriate as a self-directed mobile learning tool for the purpose of this study. In the research design, both the tablet PC and the smartphone groups were directed to create their own personalized vocabulary notebooks based on the lessons in the STS course. Within the notebook, each word was added alongside its English definition, Chinese meaning, part of speech, and sample sentences. After the participants had customized their notebooks, EngKing could then be used to take personalized quizzes or tests in the following formats: 1) word definition test, 2) word definition and pronunciation test without clues, 3) word definition and pronunciation test with clues, 4) pronunciation test, and 5) spelling test. Each vocabulary quiz was based on at least 20 random words generated from the participants’ personalized vocabulary notebooks. Thus, this self-testing feature of EngKing allowed the participants to practice according to their own needs.

2.4 Procedure

The procedure of this study lasted for a total of eight weeks. In week 1, both the tablet PC and the smartphone groups were required to attend a training session on EngKing. In weeks 2 to 6, all the participants were asked to use EngKing as a self-study tool out of class by creating their personalized vocabulary notebooks and utilizing the self-testing feature of the app to review the course content. As a way to monitor their self-study progress during this period, all participants were instructed to record in their learning logs that were collected on a weekly basis for a duration of five weeks. In weeks 7 and 8, a five-Likert scale technology acceptance questionnaire and a series of semi-structured individual interviews were used to gather the students’ opinions. The questionnaires were administered to all the 21 participants, and a total of 8 participants voluntarily participated in the interviews. In brief, the collected data for this study included: learning logs, technology acceptance questionnaires, and individual interviews. The results derived from the descriptive statistical analysis and content analysis were used to answer the three research questions, which are presented in the following section.
3. Findings

3.1 Students' Experiences of Using the Vocabulary Learning App

The first research question examined the students' experiences of using the app as a self-study tool, in terms of frequency of use and difficulty of use. An analysis of the learning logs showed that the smartphone group used the app for slightly more time than the tablet PC group (at an average of 9 and 8.7 hours per week, respectively). The higher frequency of app usage may be attributed to the fact that the students used their own smartphones, which they always carried, and thus were more accessible to them for mobile learning. However, the tablet PC group inputted more words per week than the smartphone one, at an average of 32 words compared to 22. This may be explained, in part, by the observation that data entry on smartphones is comparatively more cumbersome. As for self-study with vocabulary drills on EngKing, both groups had the same frequency, with a mean of 14 times per week.

The participants' opinions regarding their difficulties when using EngKing to learn vocabulary were collected in the individual interviews. While the majority of interviewed students had positive attitudes toward EngKing, some stated that they encountered difficulties for the following reasons: 1) It was difficult to enter words using the small virtual keyboards on the mobile devices, especially with the smartphones. 2) This app did not check the students’ spelling in their personalized vocabulary notebooks, and thus there was a higher possibility that they would learn the incorrectly spelled words rather than the words they initially had in mind. 3) Other entertaining apps, and even the Internet itself, would distract the students’ attention when they tried to learn vocabulary using a mobile device.

3.2 Students' Perceptions of Using the Vocabulary Learning App

The second research question explored the students' perceptions of using the app as a self-study tool, based on Davis' (1989) Technology Acceptance Model (TAM), which entails three major concepts of perceived usefulness, perceived ease-of-use, and behavioral intention to use. The findings were derived from the five-Likert scale technology acceptance questionnaire administered at the end of the intervention (5= strongly agree; 4= agree; 3= neutral; 2= disagree; 1= strongly disagree). The responses of “strongly agree” and “agree” were combined and reported as agreements, and responses of “disagree” and “strongly disagree” were treated as disagreements in the following report.

Based on the results of the perceived usefulness subscale, 34% of the students agreed with the survey statement “I think using mobile based application would improve my performance in this course”, while 57% agreed with the statement “I think using the app was useful to enhance my vocabulary learning”, and 43% concurred that “I could conduct more vocabulary learning activities using the app than would otherwise be possible.” Overall, approximately half of the participants had positive attitudes towards the usefulness of the app, while some of them remained neutral, and only a small percentage of them had negative feedback.

According to the results of the perceived ease-of-use subscale, 62% of the students agreed with the survey statement “I think the app was easy to use”, while 29% agreed with the statement “I think using the app for vocabulary learning did not require much mental effort”, and 57% concurred the statement “I think it was easy for me to learn how to use the app and use it skillfully.” Overall, nearly half of the participants felt that the app was easy to use, while some of them held neutral attitudes, and only a small percentage of students felt it was difficult.

In terms of the subscale of behavioral intention to use, 53% of the students agreed with the survey statement “I intend to continue using the app in the future if it is made available to me”, while 48% agreed with the statement “I intend to use the app for vocabulary learning as often as needed if it is made available to me”, and 67% concurred with the statement “I would like to use the app in other courses if it is made available to me.” Overall, a sizeable proportion of the students expressed a positive intention towards learning vocabulary using EngKing, and this result was more than double the number of those who expressed a negative intention.
3.3 \textit{Group Differences Based on the Different Mobile Devices Used}

The third research question investigated whether group differences existed based on the different mobile devices used. In terms of the overall perceptions of mobile assisted vocabulary learning, a generally positive response was found from both groups. For the statement, “In general, I think learning English vocabulary through mobile technology is a wise idea”, 77% of the participants from the smartphone group agreed with this statement, as did 67% of the tablet PC group. When comparing the two groups’ differences with regard to the three major TAM concepts or subscales, the statistical results showed that the students’ overall experiences and perceptions of mobile assisted language learning did not vary significantly based on different mobile devices used. Nevertheless, the smartphone group had slightly higher scores in the three subscales of technology acceptance questionnaire, compared to the PC group.

4. \textit{Discussion}

Previous research indicated that the small size of the screens and keypads on mobile devices are major barriers to the user acceptance of apps on such technologies (Chinnery, 2006). However, the finding of this study revealed that the students’ perceptions of mobile assisted vocabulary learning were actually better when using a smartphone rather than a tablet PC, although the differences were not significant. This finding is somewhat at odds with Stockwell (2007; 2008; 2010), as these earlier MALL studies found that higher scores were obtained when using a desktop computer compared with a mobile phone, and that the smaller screen and keypad with the latter were the main reasons for this. One possible reason is due to the advancement in smartphone technology that has taken place in recent years with regard to screen display and keypads. Another reason is that the smartphone group in the current study used their own mobile devices for learning, and thus the ownership and familiarity are possible factors that resulted in the higher self-efficacy among these users.

Furthermore, the finding that using mobile devices to learn vocabulary led to positive attitudes toward such learning is consistent with Jones, Scanlon, and Cloughs (2012), which showed that mobile devices provide both autonomy for self-directed learning and mobility in the learning process, offering a greater degree of freedom with regard to when and where one studies. In the current study, the majority of the participants noted the facilitative use of mobile technology in promoting their vocabulary learning, as it was able to enhance their learning interest by providing timely information whenever needed. Such devices can provide a learning environment that is more student-centered, without the need for scaffolding or facilitation from a real-life teacher (Facer, Joiner, Stanton, Reid, Hull & Kirk, 2004).

Despite their positive attitudes, the participants also noted some difficulties, such as inconvenience when inputting words, the lack of a spell-check function, and environmental distractions when using mobile devices to study. The first of these confirms one research finding by Gikas and Grants (2013), whose study indicated how virtual keyboards on small screens are difficult and frustrating to type. Moreover, many of the participants in the current study stated that they spent too much time creating their personalized vocabulary notebooks on the small or virtual keyboards without a spell-checker. Since the students were not provided with a vocabulary list by the instructor to serve as an integral part of the in-class materials, they had to rely on their English proficiency skills to find vocabulary items, thus requiring more time and mental effort. This study also found that distractions on mobile devices or from the environment are a potential threat to learners’ concentration, as also noted in Thornton and Housers (2005) and Stockwell (2007). Many of the participants in this study reported that while they usually carried their mobile devices with them everywhere, they did not use them for studying until they found a quiet environment, which enabled them to stay focused and avoid distractions.

5. \textit{Conclusion}

This study demonstrated that smartphones and tablet PCs have the potential to enable and enrich mobile learning. It can thus be argued that learning vocabulary via mobile technology can be
beneficial for learners by providing them with more exposure and opportunities to learn, whenever and wherever they want to. However, this study is limited in generalizability due to the small number of participants, based on the availability of tablet PCs. This study also used convenience sampling, which may have introduced some potential biases, as all the participants were selected from one available intact class, without any criteria based on proficiency levels, gender, and age. Future research may recruit more participants with a larger range of diverse backgrounds. For example, Wang, Wu, and Wang (2009) found that user acceptance of mobile learning could vary due to age and gender, and these factors may be investigated in future MALL studies.

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References


Using an online social network site as a learning community to enhance EFL learners’ cultural awareness

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Abstract:
EFL students suffer from low awareness of the target culture and low actual intercultural communicative competence due to an insufficient input and decontextualized learning environment; the current study, therefore, aimed to use Internet social networking, specifically Facebook, as a learning community framework to enhance EFL students’ cultural awareness via cross-cultural interaction with American e-pals. The participants were 15 English majored students in Taiwan and 20 undergraduate students in the U.S. The participants were asked to engage in cross-cultural communication on chosen topics (self-introduction, school life, and Taiwanese night markets or American county fairs) with the American students. A mixed method of qualitative and quantitative research was employed to analyze the data. While qualitative data included focus group interviews and reflective papers, quantitative data consisted of evaluation of the students’ cultural awareness. The major findings were: (1) Students demonstrated a moderate level of cultural awareness, (2) Using Facebook helped students to overcome the differences in time zones, to gain in cultural awareness, to clarify stereotypes, and to recognize their improvements, (3) Students found benefits in the comfortable learning environment, including classroom atmosphere, cultural awareness, authentic readers, writing skills, motivation, and autonomous learning. In conclusion, the results revealed the merits of creating an online learning community for EFL students. In addition, the framework of the instructional design provides researchers and instructors with directions to enhance the cultural awareness of students in an English writing class.

Keywords: online learning community, cultural awareness, critical thinking

1. Introduction

Language and culture seem inseparable as language is the expression of one’s cultural background. The literature is replete with statements that students’ cultural awareness facilitated the learning of a target language as students used their cultural knowledge to comprehend the sentences in an authentic learning context, as documented in Heidari, Ketabi, & Zonoobi (2014), Mitchell & Myles (2004), and Papademetre & Scarino (2006). Through the interaction, students compared and contrasted the cultural similarities and differences to achieve cultural reflection, allowing them to understand the viewpoints of the native speakers. Previous studies have indicated a close relationship between critical thinking and cultural awareness (Ingulsrud et al., 2002; Lee, 2011; McAllister et al., 2006; O’Dowd & Eberbach, 2004). To better understand the messages they received from the people in other countries, people applied critical thinking skills to achieve cultural reflection (Ingulsrud et al., 2002; Lee, 2011). Students needed the critical thinking skills, including analyzing, interpreting, and evaluating, to understand the messages of people from other countries. The critical process helped students to understand the viewpoints of others (Hanvey, 1976; Deardorff, 2006).

While some studies have focused on the use of critical thinking to clarify student misunderstandings and cultural stereotypes related to the target language (Schwarts, Lin, & Holmes, 2003; Tsai, 2011), other researchers (Deardorff, 2011; Lee, 2012; Wu, Marek, & Chen, 2013; Ziegahn, 2005) have focused on applying critical thinking to improving the cultural awareness of students with respect to cultural differences and cultural backgrounds. Among tools that facilitate student critical thinking, social
network sites, particularly Facebook, provide students an authentic context to interact with people from other countries. Through the interactive process, EFL student can analyze a conversation, comprehend the main idea of an e-pal, and accept the different cultures, as well as reflecting upon and examining their own perceptions. Students develop critical thinking skills in the process of analyzing the ideas they receive from their peers (Shih, 2011; Wass, Harland, & Mercer, 2011).

Previous research that emphasized the use of the social network site as a communicative tool to connect students with e-pals from other countries has attempted to promote the learners’ intercultural communication and cultural awareness (O’Connor, 2012; Wang, 2011). The results have shown that the students’ knowledge grows as the result of the interaction with native speakers via social network sites (Grosseck, 2009). Through sharing of information or articles, students can not only better understand each other’s cultural backgrounds but also learn from the communication, including comprehending and comparing the differences between the mother language and the target language. Asynchronous online discussion on Facebook allows students to leave messages offline and to reply to the messages anytime and anywhere. The platform not only provides students with opportunities to connect with international friends and to share messages and files but also creates a learning environment which expands the students’ ability to identify the similarities and differences between cultures (Commander, Zhao, Gallagher, & You, 2012; Liaw & Johnson, 2001; Wang, 2011; Wang, 2012). After receiving the cultural knowledge, students compare the cultural similarities and differences. Moreover, students reflect on their previous knowledge to consider whether they had some misunderstanding about the culture of the target language (Itakura, 2004).

The idea of establishing an online learning community via social media echoes the concept of Zone of Proximal Development (ZPD) and the theory of social constructivist learning (Vygosky, 1978), as well as the theory of scaffolding (Wood, Bruner & Ross, 1976), all of which emphasize the importance of social interaction and indicate that knowledge and skills, such as cultural reflection and communicative competence, progress as a result of the interaction and help of capable peers. Knowledge is produced as the result of social interaction with others, as ideas are shared and explored, making social interaction a key to learning (Pritchard & Woollard, 2010).

The current study was designed to improve awareness of the target culture and enhance actual intercultural communicative competence of EFL students in Taiwan, who often suffer due to insufficient input and a decontextualized learning environment. The researchers used Internet social networking, specifically Facebook, as a learning community framework to enhance EFL students’ cultural awareness via the cross-cultural interaction with American e-pals in an authentic context. The study particularly focused on two issues, (1) to what degree the students’ cultural awareness improved, and (2) benefits resulting from using Facebook as a communication tool.

2. Methodology

2.1 Participants

The participants were 15 English majored students (two males and 13 females) taking an advanced EFL writing course at a four-year academic university in central Taiwan. The Taiwanese participants’ writing proficiency was at the upper intermediate level because they had received training in writing for two years. The American e-pals (three males and 17 females) were undergraduate students in a multicultural communication class at a public Midwestern liberal arts college.

2.2 Instructional design

The students in the two classes were assigned to write three essays (a self-introduction, school life, and Taiwanese night markets or American county fairs) relating to their cultural and educational backgrounds, and to discuss their essays with their e-pals via private Facebook groups. The purpose of the topics was to encourage students to engage in more discussion with their e-pals, and to gain cultural awareness via the online social interaction. Facebook was integrated into this study to explore whether the students’ cultural awareness, intercultural communication competence, and critical thinking skills were enhanced via the learning community.
Students discussed issues relating to their cultural background. To help their partners to comprehend cultural issues they express, students used the functions in Facebook, including sharing messages and uploading photos as well as videos, to assist in conveying meaning. At the end of the study, the Taiwanese participants were asked to write reflective papers addressing how their understanding of their e-pal’s culture had changed. The students were asked to address five questions in their reflective papers. The questions asked about the students’ understanding of cultural similarities and differences, reflections about misunderstanding of Western culture, perceptions of using Facebook as a communicative tool, as well as overall ideas about the cross-cultural communication. Two native English speakers were recruited to analyze the reflections using a critical thinking analysis framework developed by Wu, Marek, and Chen (2013), including cross-cultural recognition and reflection.

A mixed method of qualitative and quantitative research method was employed to analyze the data. While qualitative data included focus group interviews and reflective papers, quantitative data consisted of the evaluation of the students’ cultural awareness.

3. Results and discussion

3.1 Cultural awareness in cross-cultural interaction

In terms of cultural awareness as the result of using an online cross-cultural learning community, the American reviewers and the researcher in this study evaluated the reflective papers of 15 students. All of the reflective papers were examined through critical text analysis. In the analysis, the students’ cultural awareness (A) was determined by the number of cross-cultural recognitions (C) in which the students noted particular differences or similarities in two cultures), and reflections (R) in which the students compared and contrasted the recognized difference or similarity. Ideally, there would be one reflection for each recognition. The formula A=R/C was applied to assess the students’ level of cultural awareness.

The data for recognitions varied between three and 10, as evaluated by at least one of the reviewers. The data for reflections by individual students varied from one and six identified by the reviewers. The reviewers found an average of 6.53 recognitions in each paper and an average of 3.53 reflections per paper. Applying the A=R/C formula, the researchers determined that the students averaged .56 reflections per recognition, defined as a cross-cultural critical thinking (A) value of 56 %, suggesting that the students in the current study performed critical thinking at a moderate level (see Table 1) and that students were not always able to compare and contrast the differences deeply even though they were aware of cultural differences.

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The students’ lack of ability in cross-cultural critical thinking is not surprising. This was the first experience for the Taiwanese students in a curriculum design intended to cultivate their critical thinking.
skills, making it difficult to train the students to think critically in a short period of time. The typical learning environment in Taiwan does not teach or encourage critical thinking. In previous classes, the students in this study had most often received information from teachers and followed the guidance of their teachers, including detailed instructions about the content of compositions as well as the concepts behind the topic. The students’ development of critical thinking, therefore, was inhibited by the learning environment of previous classes.

3.2 Benefits of using Facebook as a communicative platform

With regards to the benefits of using Facebook as a learning community platform for cross-cultural collaboration, students expressed their beliefs about the benefits of the powerful functions of Facebook. Using Facebook helped students to overcome the differences in time zones, to improve in cultural awareness, to clarify stereotypes, and to record their improvements. Using portable devices to connect to Facebook via the Internet enabled students to leave offline messages. Therefore, no matter what country the students were in, they replied and received the message at any time after connecting to the Internet. Moreover, the students found Facebook to be much more convenient than the older method of cross-cultural communication consisting of sending international letters.

Before having opportunities to interact with native speakers, students received their cultural knowledge from soap operas, movies, or books. This resulted in cultural stereotypes. On the other hand, when they had the opportunity to interact with native speakers, students received authentic information which clarified their misunderstandings. The Taiwanese participants also were pleased by their improvement in use of American slang. They thought that the most powerful function of Facebook is that it links friends together. Therefore, the opportunity to interact with native speakers meant that they could also read the messages which the e-pal exchanged with other American friends. In this way, they were able to examine and emulate the writing style and the vocabulary used by the native speakers in an authentic context.

Overall, as a platform for engaging in cross-cultural communication, students in this study perceived that Facebook overcame the problem of time differences between the two countries. Through uploading photos and videos, students comprehended the objects and activities which were described by their e-pals. Their cultural awareness was increased through the process. Furthermore, when communicating with the native speakers, the students were able to more deeply understand the culture and life and to learn from the slang which native speakers used while chatting with their e-pals. Also, students found that interacting with native speakers in an authentic environment caused them engage in self-reflection and to clarify misunderstandings. Overall, the students considered that interacting with native speakers through the social learning community was a positive experience.

4. Pedagogical implications and suggestions

The EFL teacher should help students to promote critical thinking in the context of reflection about culture. For instance, to enhance the students’ critical thinking skills, teachers can require students to write a culture-related essay. Through this process, students will have the opportunity to compare and contrast the cultural similarities and differences. To guide students in their cultural reflection, teachers should use open-ended questions. After students achieve a deeper understanding of the culture of target language, the teacher can continue the activity and offer students opportunities to write a culture-related research paper which may also help students to understand the culture more deeply and to practice cultural critical thinking.

The EFL teacher should use social network sites to form learning communities for students to scaffold the abilities of each other. Given that EFL students in Taiwan have less opportunity to practice their writing abilities, online interaction on social network sites enable students to better understand the western culture.

Future studies could include the American students’ opinions and reflections about the interaction. In-depth interviews with the American students could also be adopted so that their feedback provides additional insights into the effect of online social network use on EFL learners’ cultural awareness.
References


A Tagging Editor for Learner Corpora
Annotation and Error Analysis

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Abstract: In this paper, we describe the development of the tagging editor for learner corpora annotation and computer-aided error analysis. We collect essays written by learners of Chinese as a foreign language for grammatical error annotation and correction. Our tagging editor is effective and enables the annotated corpus to be used in a shared task in ICCE 2014.

Keywords: Computer-aided error analysis, learner corpora, interlanguage, Mandarin Chinese

1. Introduction

Learner corpora are the collection of foreign language learners’ produced responses, which are valuable resources for research of second language learning and teaching. For example, the International Corpus of Learner English (ICLE) is considered as one of the most important learner corpora. ICLE consists of argumentative essays written by advanced learners of English as a Foreign Language from different native language backgrounds (Granger, 2003). The first version was published in 2002. They are currently working towards the third version of this corpus. In addition, the Cambridge Learner Corpus (CLC) is made up of more than 200 thousands of examination scripts written by English learners speaking 148 different mother languages (Nicholls, 2003). CLC was established to assist English Language Teaching/Training (ELT) publishers to create aided materials, e.g., Cambridge dictionaries and ELT course books, addressed to their target users.

Annotated learner corpora play an important role to develop natural language processing techniques for educational applications. As an example, Assessing LEXical Knowledge (ALEK) system (Chodorow and Leacock, 2000) adopted statistical analysis from learner corpora to detect the errors of an English sentence. Izumi et al. (2003) detected English grammatical and lexical errors made by Japanese learners. Lee et al. (2013) proposed a linguistic rule based approach to detect grammatical errors written by learners of Chinese as a foreign language. Recently, the CoNLL 2013/2014 shared tasks focus on grammatical error correction for learners’ English as a foreign language (Ng. et al. 2013). SIGHAN 2013/2014 bakeoffs on Chinese spelling check evaluation focus on developing automatic checker to detect and correct spelling errors (Wu et al. 2013).

However, to make learner corpora useful for these tasks, they must be annotated correctly before automated analysis can be applied. In this work, we design a tagging editor to help annotators to insert error tags and rewrite correct usages for the sentences in the learner corpus. In addition, our editor provides the function for error analysis, which further assists annotators to instantly discover incorrect or inconsistent tagging instances during the annotation process.

2. The Error Tagging Editor

The construction of a tagging editor includes designing tag-associated error categories arranged on a menu interface, which can help annotators to select and insert error tags alongside the wrong part of
the learners’ written texts. In addition to error tagging, reconstruction of correct usages is usually needed in the annotation process. After the learner corpus is tagged and corrected, error analysis can be done quantitatively according to various kinds of users’ interests.

Figure 1 shows a screenshot of the tagging editor. The functions of our tagging editor can be divided into three main parts: (1) Searching zone (the left panel): learners’ written texts are stored in individual files accompanying with their metadata, such as the level describing the learner’s language proficiency, the score of the learner’s written texts, and the learner’s mother-tongue language (ML). Our tagging editor can search learners’ texts using these fields of metadata. The searching results can be listed in order by the unique ID with the (tagging | correction) status. The symbol “O” means a finished situation. In contrast, the symbol “X” represents that the texts need to be annotated. (2) Tagging zone (the middle panel): when the texts are loaded in this zone, annotators can select and insert error tags from the menu bar into some position of learners’ texts. Inserted tags are shown in terms of square brackets in red color. (3) Correction zone (the right panel): annotators usually need to correct the error parts for correct usages. Correction zone is aligned paragraph-wisely with tagging zone to facilitate annotators’ corrections. We highlight the changed texts in blue color. Besides, our tagging editor also reports error analysis, which benefits annotators to find incorrect/inconsistent tagging instances to be fixed in the verification procedure.

Our tagging editor is flexible enough to meet various annotation tasks for learner corpora in different language. The character encoding is in Unicode; the editor is developed in Java; both of which are cross-platform. Besides, annotators can add, delete or fix their self-defined error tags for their annotation tasks. The metadata is also optional. The tagging editor could load the learners’ written texts even without the accompanying metadata.

3. The Annotation of TOCFL Learner Corpus

The annotated corpus using this tagger editor is mainly from the computer-based writing Test of Chinese as a Foreign Language (TOCFL). The writing test is designed according to the six proficiency levels of the Common European Framework of Reference (CEFR). Test takers have to complete two different tasks for each level. For example, for the A2 (Waystage level) candidates, they will be asked to write a note and describe a story after looking at four pictures. All candidates are asked to complete the writings on line. Each text is then scored on a 0-5 point scale. Score 5 means high-quality writings, score 3 is the threshold for passing the test, and so forth. There are 4,567 essays collected in the corpus so far.

For the purpose of studies in Chinese learners’ interlanguage, hierarchical error tags are designed to annotate grammatical errors. There are two types of error tagging, one is target modification taxonomy, the other is linguistic category classification. The former includes four PADS error types: mis-ordering (Permutation), redundancy (Addition), omission (Deletion), and mis-selection (Substitution). The latter includes 36 linguistic types, e.g., noun, verb, preposition,
specific construction, and so on. Using our tagging editor, 51 essays belonging to CEFR B1 level with score 5 had been annotated by two linguists at the same time. Figure 2 shows the distribution of error tags sorted by their occurrence. In total, there are 678 errors in 51 essays. The top 3 error tags are: Sv (mis-Selection of verbs), Madv (Missing of adverbs), and Sn (mis-Selection of nouns). Their frequency is 53, 40, and 39, respectively. In the above error tag abbreviations, the first capital letter of the tag represents the higher level of error tagging.

![Figure 2. Distribution of error tags in the annotated corpus](image.jpg)

### 4. Conclusions and Future Work

This article describes our tagging editor that can be employed to meet annotation tasks in learner corpora. This tagging editor is effective to annotate grammatical errors in CFL learners’ essays. We will further collect annotators’ feedbacks and discuss with them to enhance its functions. We shall release this editor for public use in the future. The corpus annotated by this editor described above has currently been used for a shared task in the ICCE workshop.

### Acknowledgements

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### References


Developing and Evaluating a Test Generation Module to Support Personalized Phoneme-based Training

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Abstract: In this paper, we describe a test generation module to support personalized phoneme-based training in listening learning of English vocabulary. On the basis of the personalized phoneme error patterns detected by an error detection module, the test generation module would generate personalized listening tests. An evaluation experiment was conducted for evaluating the module.

Keywords: CALL System, Data Mining, Adaptive Learning, English Vocabulary Learning, Phoneme Perception

1. Introduction

In the past decade, adaptive learning has become considerable and there is a trend to develop the applications to generate adaptable materials. The trend also influences the field of computer assisted language learning (CALL). Item response theory was used to evaluate individual English vocabulary ability and a personalized mobile English vocabulary learning system has been developed (Chen and Chung, 2008). As enhancing communication skill becomes more and more important in foreign language education, CALL systems have been widely used in Japan as well. By CALL, students’ learning log-data can be easily saved in database and the saved log-data gives us the possibility to automatically create and offer contents to students to guide their own learning processes or improve their weak points (Ueno, 2007). However, it has not been enough explored how to build personalized systems for listening learning.

On the other hand, it has been indicated that word recognition is the core process in listening of English (Rost, 2002). In some cognitive models of speech perception such as the cohort model, phoneme perception is considered as one of the key factors. In classroom education, it is well-known that Japanese learners have difficulties in distinguishing some special phonemes such as /r/ and /l/ (Horibe and Furuhashi, 1974) so that the phoneme-based training has been indicated to be an important learning strategy in vocabulary learning. Therefore, we consider that detecting individual weak-points at the phoneme level and conducting personalized phoneme-based training may help the individual enhance the listening comprehension ability in vocabulary learning.

In this paper, we describe a test generation module to support personalized phoneme-based training in English vocabulary learning. For a student, the log-data in word dictation tests are analyzed and the student’s error patterns at the phoneme level are detected by the use of the error detection module developed in our previous work (Zou, Kashiwagi, Ohtsuki and Kang, 2013). On the basis of the error patterns, the test module will generate a test with alternative response questions for the student who is requested to discriminate minimal pairs of English words. In addition, an evaluation experiment is conducted in order to evaluate the module.

2. Vocabulary Test System and the Error Detection Module
We built a vocabulary test system in AMP (Apache, MySQL, and PHP) environment implemented the error detection module and the test module. The error detection module was targeted at analyzing the log-data in word dictation tests in that students are requested to input the spellings of English words as English answers and Japanese translations corresponding to the words.

In the error detection module, we have focused phoneme error detection on the detection of misperceptions, e.g. “slips of the ear” (Rost, 2002). We manually checked the wrong spellings and the corresponding right spellings in the past log-data and noted that most of the wrong answers could be categorized into mistakes of misperception. Most of the wrong answers were given as different English words in that only one phoneme or two phonemes are different from the right English words. We have used Japanese translations to examine whether a wrong spelling of a word represents the misunderstanding of the word or not. We suggested that wrong spellings mostly are in agreement with misunderstanding of words because there were only few answers in that the spellings of words were wrong but their Japanese translations were right. Certainly, the suggestion depends on the log-data collected.

According to the implemented algorithm, the error detection module would first decompose a right answer and a corresponding wrong answer into phonemes by the use of the CMU Pronouncing Dictionary (CMU pronouncing dictionary, n.d.), and then extract the phoneme error pair. Finally, the personalized phoneme error patterns would be detected by the use of the Apriori-like method in sequence data mining and be described as /Right-Phoneme/ -/Wrong-Phoneme/.

3. Test Generation Module

On the basis of the detection result by the error detection module, the test generation module would generate a test with alternative response questions in order to help an individual student or group distinguish phonemes that he/she or they mistook. We consider that the more a pair occurred in the results, the more it turns difficult for a student to distinguish the pair. In this work, the top error pair that is most frequently occurred in error patterns is selected to be the training target.

In a test generated by the module, each question consists of two words that are minimal pair and correspond to a phoneme error pair respectively. The words are randomly picked out from the minimal pair database. As an example, for the phoneme pair /r/ → /l/, a minimal pair would be the words “rock” and “lock”. One sound file corresponding to each minimal pair would be generated by the use of AT&T Natural Voice Engine.

4. Results in the Evaluation Experiment and Future Work

In order to evaluate the module, we conducted an evaluation experiment. We attempted to find out if the module can generate appropriate tests for training for individual students and if the training is effective to help students enhance their listening comprehension ability in vocabulary learning.

We designed a pretest-training-posttest experiment. In each pretest, a student needs to answer 20 word dictation questions. Once he/she submitted the answers, then a web page with his/her phoneme error patterns and 10 alternative response questions will be shown to him/her for training. After the training, the posttest with 15 word dictation questions will be presented. Each test for training and corresponding posttest are automatically generated by the test generation module.

In the experiment, we had two third-year students and two fourth-year students take four pretest-training-posttests numbered Test I, II, III and IV in one month period. We randomly chose the subjects from the students who have completed all necessary English courses provided by the university. The words both in the pretests and the posttests of Test I, II and III were randomly selected from the JACET 2000 list and the words in Test IV were those selected from the JACET 4000 list (JACET Vocabulary, n.d.). Students were previously requested to declare what phoneme pairs are difficult to distinguish and answer a paper-based test that measures vocabulary levels in reading. The result of the paper-based test shows that the subjects can understand almost all of words in the JACET 4000 list. This was aimed at decreasing spelling mistakes in the answers of the subjects. In the previous investigation, Student A and Student B declared that the /r/-/l/ pair is the most difficult pair to distinguish while Student C and Student D declared that the /v/-/b/ pair is the most difficult one.
Table 1 shows the auto-generated tests for Student B by the module. It is obvious that all tests for training are appropriately generated by the module although there are some duplicate minimal pairs.

Table 1. Auto-generated Tests For Phoneme-based Training

<table>
<thead>
<tr>
<th>No.</th>
<th>Error Pairs</th>
<th>Words in Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>/v/-/b/</td>
<td>vow-bow, rebel-revel, dub-dove, vein-bane, bale-veil, bane-vain, vent-bent, bale-veil, vat-bat, beer-veer</td>
</tr>
<tr>
<td>II</td>
<td>/t/-/l/</td>
<td>bright-blight, loot-root, glamour-grammar, rite-light, arrive- alive, flee-free, lock-rock, rocker-locker, ray-ray, rob-lob</td>
</tr>
<tr>
<td>III</td>
<td>/i/-/i:/</td>
<td>sip-seep, skim-scheme, kill-keel, bid-bead, bin-bean, skim- scheme, slip-sleep, ill-eel, piss-peace, slick-sleek</td>
</tr>
<tr>
<td>IV</td>
<td>/i/-/i:/</td>
<td>din-dean, piss-piece, sin-scene, shin-sheen, din-dean, piss- piece, sip-seep, each-itch, fist-feast, hip-heap</td>
</tr>
</tbody>
</table>

We examined the phoneme error pairs in the pretests of the subjects. It is noted that Student A had the same problem in all of the tests that she possibly cannot distinguish /r/ and /l/ very well as she declared. On the other hand, the weak points of the other subjects seem varying with the pretests as shown in Table 1. After the experiment, we manually performed the error detection module to deal with three kinds of accumulative pretest data that consists of the data in Test I and Test II, the data in Test I, II and III, and the data in Test I, II, III and IV, respectively. We noticed that the accumulative pretest data would provide a more stable result about the error pairs of all subjects. For Student A, the most difficult phoneme pair to distinguish is still the /r/-/l/ pair. For Student B, Student C and Student D, the /v/-/b/ pair become the most difficult one.

For investigating the effect of the tests for training, we compared the correct answer rates of the words in the pretests and the corresponding posttests by categorizing the words to the corresponding error pairs. The result by Fisher’s exact test explains that there is a significant improvement in the posttests for Student A. However, there is no significant improvement observed for Student B, Student C and Student D. This may stem from whether the module detected the real weak points of the subjects or not. The consistency of the error pairs in the pretest data and the accumulative pretest data assume that the /r/-/l/ pair seems to be the real weak point of Student A. Conversely, for the other subjects, the module possibly has not appropriately estimated the real weak points.

Therefore, we assume that the auto-generated tests for training may help students enhance the perception of phonemes if the training targets are appropriately determined. For the question about how to make the auto-generated tests for training more effective, further investigation is needed.

Acknowledgements

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References

Enhancing EFL Learning of Elementary School Students through Human-Robot Interaction

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Abstract: This study explored the potential for using in-house built teaching assistant robots in elementary school classrooms for the instruction of English as a Foreign Language (EFL). Both hardware and software design for such an innovative English program via interactions with the robot was included in this study. This Human-Robot Interaction (HRI), based on the results, led to better pedagogical effects on learning. This paper provides not only new directions for EFL instructors but also instructional design guidelines that other researchers can follow to create an innovative and enjoyable English classroom that employs an interactive robot as an assistant for enhancing English acquisition while simultaneously reducing the pressure and teaching load of the English instructors.

Keywords: teaching assistant robot, HRI, EFL, r-learning

1. Introduction

The robot industry is recognized as one of the most promising future industries throughout the world (Han, Jo, Jones & Jo, 2008). While a significant number of studies have revealed that r-Learning (Robot Learning) can bring new affordances to education, i.e. new capabilities, experimentation in r-Learning has mainly occurred in the fields of mathematics and science, the disciplines that actually develop the robots. The literature addressing the value of using educational robots to support second/foreign language learning is still skimpy. Chang, et al, (2010) echoed this observation by stating that only a few researchers have focused their attention on implementations of robotics for language teaching in elementary schools, and most have been located outside the cultural context of Taiwan. In recent years, there have been studies integrating applied robotics with education (Ryuey et al., 2008); however, research into robot assisted teaching and learning is still in its infant stages; therefore, more and more researchers are joining in the exploration of this field. The experimental results have shown that a communication robot can support human activity with its communication abilities, that proper programming can motivate children to desire additional interactions with the robot, and that robots have the potential to exhibit certain beneficial social skills when interacting with young children, the target population of the current study.

2. Hardware and Software Design of Teaching Assistant Robots

In view the obstacles to optimal English learning environments and the merits of using teaching assistant robots to facilitate language acquisition in the classroom, an intelligent teaching assistant robot named Powerful English Tutor (PET) was designed and created by the researchers to combine r-Learning functionality with a unique 3D visual experience. PET had the capability to exhibit various forms of communication and interaction with the student learners, such as facial expression, gestures, and motions on wheels. The main purposes of the creation of PET included (1) first to capture the students’ attention as a result of PET’s novel appearance, (2) then to motivate students to learn and to sustain their learning by engaging them with PET, and (3) eventually to ensure the students’ mastery of the learning materials by interacting repeatedly with PET. The first author of this paper had been
involved in designing and producing robots successfully for several years and therefore brought significant expertise to this project.

![Figure 1.](image)

In order to fully support the instructional design of the class and achieve desired learning outcomes, the researchers employed a conceptual framework for this study based on three major theory-based teaching approaches to create an interactive learning environment for students including Communicative Language Teaching (CLT), Total Physical Response (TPR), and Storytelling, each incorporated into the databases that governed and managed PET’s moment-by-moment actions. The CLT approach was used in the construction of databases for the teaching of self-introduction, conversation teaching, and teaching via storytelling. The TPR approach was applied in developing databases covering English character teaching, making use of entertaining body movements, singing, and dancing in order to help students internalize their lessons. The Storytelling approach was used in preparation of the databases for story teaching and learning.

The theory-based creation of PET’s physical appearance was an important factor in the study. The upper part of PET was android in nature, with a head, face, ears, and arms, appearing similar to the cartoon characters familiar to the elementary school children. In particular, PET’s face appeared on an LED display of 20×20 centimeters that could show smiles and a variety of other expressions (see figure 1). The lower body of PET was wheeled, to make it easily mobile. The android part of the body was able to imitate many kinds of human actions as well as perform a variety of teaching activities.

This physical design of PET was based on the need described in the introduction for an external appearance that was human-like or cartoon-like, with the following specific criteria: (1) The appearance of the robot must be appealing and interesting in order to attract the attention of young children; therefore, the researchers chose a humanoid structure with various cartoon-like elements appropriate to the needs of the curriculum (see Figure 1); (2) A 10.1” Tablet computer needed to be embedded in the robot’s chest to show multimedia teaching content and to interact with students such as to increase the students’ attention and motivation; (3) The upper part of the robot needed to imitate many kinds of human actions as well as perform a variety of teaching activities; (4) The robotic hands needed to easily hold teaching materials and English character cards to keep the attention of the students; and (5) The price of this robot, should it reach commercial production, needed to be reasonable for general classroom and family use.

3. Methods and Outcome

This study involved 31 third grade students who had participated in four consecutive rounds of robotic English teaching, each lasting about 50 minutes in length. The instructional design in this study employed the three major teaching approaches in the conceptual framework, Communicative Language Teaching, Total Physical Response, and Teaching Storytelling. PET visited the class four times, for about 50 minutes each time. The lessons were about the 26 English letters, self-introduction and body parts, conversation, and storytelling. The proficiency test was conducted at the end of the fourth season. Besides, a survey about the use of PET was administrated to the entire class and a focus group interview with 5 students was conducted afterwards with the consent obtained from their parents. Finally, the researchers’ own classroom observations and video recordings were also used as a source for data collection.
The overall mean score of 4.2 (M=4.2) for the cutting-edge English instruction using PET indicated that generally speaking, the students were positive about their learning with PET in terms of elements such as joyfulness, interest, and motivation associated with their English learning. A negatively-skewed distribution of responses indicated the very successful role PET played in assisting teaching. When it comes to item-by-item data analysis, item 16, “I am looking forward to our future study of English in class” had a highest mean score of 4.53 (M=4.53), followed by item 10, “I’m willing to perform on the podium” with a second highest mean score of 4.52 (M=4.50). Item 11, “I like the pleasant atmosphere when studying the English in class” and item 6, “This is a fun and interesting English class” had a relatively high mean score of 4.36 (M=4.36) and 4.28 (M=4.28), respectively, which proved that using robots as teaching assistants in class created a more pleasant learning environment as well as a more positive learning experiences.

The interview data also indicated that the students enjoyed having PET because it helped the instructor to teach English and also believed that PET performed its job well. Student D mentioned that “This English study with PET was a very interesting and fun experience because PET could perform a variety of different movements and also served as a good teaching assistant.” In addition, the students believed that PET could enhance their motivation to study English and that HRI could also be valuable in other classes. Student A said, “I wish that PET could be here in class all the time and could also appear in the other classes to help us learn the other subjects because I feel I’m more motivated to study English.” Student C focused on the issue of confidence in studying English by saying, “I felt more confident and less anxious when PET was there, especially when being asked questions.”

The observation from the teacher reveals that PET assisted her in teaching by reducing the pressure and load of teaching and said that she would love to continue using PET as her teaching assistant in the future. She also found that the operation and interface of PET was simply and user friendly, but saw the need for an improvement in the richness and complexity of teaching materials, should PET be integrated into a semester-long lesson plan. To summarize, the multiple sources of data collected from both the teacher and the students showed that teaching assistant robots were highly valued and strongly recommended for in-class English instruction.

4. Conclusion

Given the world-wide need to teach younger and younger children foreign languages, and the resulting need to develop language teaching methodology suitable for these younger children, it is natural to assume that technology should play a prominent role. The researchers have demonstrated that a teaching assistant robot, such as PET, can accomplish multiple goals, such as fostering positive learning experiences, promoting active learning, motivating young students to learn, improving learning effectiveness, and providing a counterpoint to teacher-led classroom lessons. The researchers also believe that teaching assistant robots like PET could also be used to help teach other languages to younger children, with appropriate alternative databases. The researchers, therefore, have concluded that this field, using Human-Robot-Interaction to support EFL instruction for young students, has high potential and is deserving of extensive attention in the field of both education and technology development.

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References
Essay Development Schemata to Support English Composition

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Abstract: We propose essay development schemata to support learners in English essay writing. The schemata are expressed by unified vocabulary in unified level of detail. Since essay structures are expressed as such schemata, learners will be able to know what the structures of essay exist, recognize how each structure is different, and what kinds of information are necessary for composing a type of essay. Computers, moreover, can support learners in composing essays by referring to the schemata as the knowledge of the logical structures of English essay.

Keywords: English Learning, EFL Learning, Essay Writing, Paragraph Writing, CALL

1. Introduction

One of the most difficult tasks for English as a foreign language (EFL) learners is to compose a long persuasive passage. In order to compose such sentences in English, we need to have the knowledge of not only words and grammar, but also the logical structure of English. However many EFL learners do not have sufficient knowledge of the logical structure.

Although many intelligent computer-assisted language learning (ICALL) systems and support systems for composing sentences have been developed, it is difficult for these systems to support users who have insufficient knowledge of the logical structures of English. For example, Criterion (Educational Testing Service, 2007) and Writer’s Companion (Visions Technology in Education, 2007) are useful systems. They, however, give users only templates which correspond to typical logical structures because target users of these systems are basically people who have the knowledge of logical structures. These systems may not provide enough support for users who have insufficient knowledge of logical structures of English.

We have already focused on the logical structure of paragraphs, defined paragraph development schemata which express typical logical structures, and implemented support systems for organizing paragraphs (Kunichika, Miyazaki and Takeuchi, 2009). At present, we are now focusing on English essays composed of several paragraphs. In order to implement support systems for essay writing, the purpose of this work is to define the knowledge of the logical structures of essays. In this paper, we describe the knowledge and its utilization.

2. Essay Development Schemata

When we look for instructions on essay writing, we can find many textbooks. However, it is difficult for EFL learners to understand explanations of logical structures, because the types of structures introduced in books differ, vocabulary and the level of detail are not unified and there are only a few examples. Moreover, because the definitions of logical structures are written in natural language, they still have ambiguity and it is difficult for computers to treat them as knowledge without changing their formats.
In order to implement support systems for essay writing, computers need to have knowledge of logical structures of essays. There are different types of essays, depending on the purpose people have for writing an essay. Although an essay basically has three parts: introduction, body and conclusion, the details of the body vary according to the type of essay. Thus, computers need to know the detailed logical structure that corresponds to the essay type.

We examined eighteen textbooks for essay writing, e.g. (Chin, Reid, Wray and Yamazaki, 2012) and (Folse, Muchmore-Vokoun and Solomon, 2010), and identified seven types of essays: Argumentative, Narrative, Comparative, Cause-and-Effect, Process, Descriptive and Classification. After that, we formalized information on the logical structure of each type, and defined the knowledge as schema called essay development schema (EDS). The knowledge of logical structures can be defined by the following information.

- **Structure**: Structure expresses the logical structure of an essay, and is defined by a sequence of the roles of components in an essay. Thus, components of structure correspond to paragraphs. Because the type of a paragraph is restricted according to the role of the paragraph in an essay, Structure also expresses the relationships between the roles and the types of paragraphs.

- **Explanation**: What and how should be described in each component of Structure. Explanation is expressed in natural language, and referred by learners, e.g. when composing the outline of an essay.

- **Tip**: Important points for composing a good essay and/or matters that require attention. Tip is also expressed in natural language. It is useful when revising an essay.

- **Words and phrases**: Information on words and phrases frequently used in a type of essay. The information consists of words, their parts of speech, the component of Structure in which the words are used, and restrictions on their use. Words and phrases are used for selecting appropriate words, e.g. a computer suggests words when rewriting an essay.

- **Condition**: Some EDSs have two types of logical structure. Condition expresses the information for selecting the type of logical structure.

EDSs are expressed by unified vocabulary in a unified level of detail. Since the logical structures of an essay are expressed as EDSs, we can reduce their ambiguity. That is to say,

![Figure 1. The EDS of an argumentative essay](image-url)
learners and computers will be able to know what types of essays exist, how each logical structure differs, and what kinds of information are necessary for composing a type of essay.

As an example, we show the EDS of argumentative essay in Figure 1. In structure, squares are components, i.e. paragraphs, numbers attached to components express repetitions of the components, and names in square brackets are types of paragraphs corresponding to the component. There are two types of logical structures: one is block organization and the other is point-by-point organization. Selecting one type of structure depends on the number of items or the policy of an essay. For example, when four or more items are described, point-by-point organization is suitable. Condition expresses such relationships as shown in Figure 1. Words and phrases keeps information on words and phrases frequently used in each component of structure.

3. Utilization of Essay Development Schemata

EDSs can be referred to by learners and computers as knowledge on essay writing. We give you examples of the utilization of EDS in this section. The writing process of an essay consists of four steps: pre-writing, drafting, reviewing and revising, and rewriting. The first step of the essay writing is pre-writing. In this step, authors need to gather ideas they will use to write about the topic, and organize the essay. That is, deciding which of the ideas they will use and where they will put the ideas in the essay. For learners who are unfamiliar with organizing an essay, computers will be able to propose some outlines of essays. When learners gather ideas, our system asks them to express the roles of the ideas in the paragraphs and essays. The system composes the outlines of paragraphs by referring to the roles of the ideas in the paragraphs (Kunichika, Miyazaki and Takeuchi, 2009). Next, the system selects several of the paragraphs by referring to the roles of both the gathered ideas and components of structure of an EDS, and puts each outline of the selected paragraphs into the appropriate component of the structure by also referring to condition. By repeating these processes, the system will be able to compose several essay outlines and propose them to learners. We have defined the knowledge of logical structures in a computer readable format. Therefore, computers can automatically compose the outlines of essays although already-existing systems give users only templates of essays.

4. Conclusions

We have defined EDSs which express typical logical structures of an English essay, and described their utilization. As our future task, we will evaluate EDSs and implement an English composition support system with EDSs for the four steps of essay writing. Moreover, we will expand this work from an essay to a larger unit such as a paper.

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References

Fostering college students’ reading comprehension with online annotations

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Abstract: The study aims to investigate students’ progress in reading comprehension in an online annotation system. This study adopted quantitative and qualitative methodologies. The results showed that students made significant progress in reading comprehension after receiving instruction with online annotation. Moreover, students who made more progress employed the strategies of questioning and annotation more frequently than those who made less progress. To sum up, instead of solely teaching multiple reading strategies, it was recommended that multiple reading strategies should incorporate online annotation for helping students overcome their reading difficulties.

Keywords: Reading comprehension, reciprocal teaching, online annotation, collaborative learning

1. Introduction

Concerning the issue of improving college students’ reading comprehension, a substantial body of research has suggested that teaching reading strategies is one of the most effective means for helping students to overcome difficulties whilst reading (Dreyer & Nel, 2003). Rhoder (2002) stated that teaching students to apply reading strategies allows learners to become more active and engaged in their reading process. By making good use of reading strategies, students are able to solve certain problems so as to overcome comprehension failures. Therefore, teaching readers how to use effective reading strategies is an essential procedure in the reading classroom, and thus should be integrated into classroom instruction.

Among the studies which employ multiple strategies in reading comprehension, Reciprocal Teaching (RT) has been reported as an effective method to enhance learners’ reading comprehension (Alfassi, 1998; Fevre, Moore, & Wilkinson, 2003). One possibility to solve existing problems of reading instruction is to combine RT instruction with peer-assisted learning arrangements in which students read and annotate collaboratively (Spörer, Brunstein, & Kieschke, 2009). According to Su et al. (2010), annotation is a useful strategy as it leads the learner to engage with the content to be annotated to ensure both its relevance and significance is understood. Likewise, Robert (2009) further stated that annotation practices are particularly useful for knowledge sharing within collaborative learning frameworks. In general, annotation has been considered as an effective strategy since it helps collaborative learning by allowing learners to: (1) draw attention of group members to a specific content, (2) organize and discuss the new material, (3) review others’ thoughts in the form of annotations, and (4) improve through receiving feedback and corrections from instructors or experienced learners.
Since taking notes is a common behavior that occurs in the classroom, there is a need to provide annotation systems even in online learning environments as well. Several studies have shown the positive effects of online collaborative annotation on learning performance (Marshall & Brush, 2004; Robert, 2009). To this end, this study attempts to combine RT with a collaborative annotation system to compensate the difficulty of current teaching challenges, and then report on the effectiveness of reciprocal teaching incorporating the online annotation system to support teachers and students in college reading instruction. In addition, the differences in strategies used among students who made more progress and less progress when undergoing RT procedures are investigated.

2. Design of the Reading Instruction Incorporating an Online Annotation System

2.1 Reading Instruction

The course was designed based on the instructional framework of reciprocal teaching proposed by Brown and Palincsar (1984). The key strategies of reciprocal teaching include predicting, clarifying, questioning and summarizing. During the 12-week study, students were instructed in four strategies of RT. After receiving the explicit teaching, the online annotation system was introduced to the students. Through the online annotation system, peers not only can collaboratively read and annotate the texts, but also share the ideas and reading strategies. Additionally, since students’ reading behavior, reading process and their collaboration with peers in small group discussion can be recorded, scaffolding can be provided for the peers and instructors when they encounter reading difficulties.

2.2 Online Annotation System

This study takes advantage of multiple functions provided by Google Docs to incorporate in reading instruction. The annotation tool is the main function that the students use when undergoing RT procedures. Student can exert this tool to highlight and annotate unknown words, keywords, topic sentences, and supporting ideas. In addition, the students were asked to write down the main ideas of each paragraph, and then integrate them into a summary. In this online setting, they can independently as well as collaboratively annotate the texts based on reciprocal teaching procedures. The document shared mechanism allows students to share their notes, invite others for collaborative reading and provide collaborative annotation of the texts. In this online setting, students can observe peers’ work, discuss with their peers and give responses to peers’ annotation of the text. The chat room is a common online learning environment. The students can use this space to generate questions, and process a thread of discussion with their peers in more natural conditions. Besides, with this chat room, the instructor can immediately provide some prompts to scaffold students once they encounter difficulties.

3. Conclusion

The result of this study showed that students made significant progress in reading comprehension after receiving reciprocal teaching with online annotations. Moreover, the differences in strategies used among students who made more progress and less progress when undergoing RT procedures were identified. Students who made more progress employed the strategies of questioning and annotation more frequently than those who made less progress. To sum up, it was recommended that multiple reading strategies such as reciprocal teaching should be integrated into reading classrooms since students’ reading performance was improved after receiving reciprocal teaching. Furthermore, when implementing the RT, it is suggested that the instructor can incorporate the online
annotation for helping students overcome their reading difficulties.

Acknowledgement

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References


Game-based Mobile Learning Companion for L2 Vocabulary Acquisition

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Abstract: With the emerging development of Digital Game-Based Learning (DGBL), a growing body of research has begun to explore the effectiveness of gamification of language learning. This paper introduces an evolving study which aims to explore the effectiveness of a mobile learning companion game, named “MyEVA (My English Vocabulary Assistant) Mobile”, which was originally developed by combining the metacognitive and cognitive strategies and mobile gaming technologies. In the current status of this study, the proposed system has finished development and continues to elaborate the usability according to the language experts and student suggestion. In the future, a mixed research will be conducted to investigate whether flow and enjoyment lead to improvement in L2 vocabulary learning.

Keywords: Digital game-based learning (DGBL), game-based language learning, L2 vocabulary learning

1. Introduction

Digital Game-Based Learning (DGBL) has become a new medium of reference in the language learning field over the past few years. Cornillie et al. (2012) explored learner perceptions of corrective feedback in an immersive game for English pragmatics. Miller and Hegelheimer (2006) employed a strategic life simulation video game, “The Sims”, with tree-condition experimental design (access mandatory supplemental materials / voluntary access to supplemental materials/ with no supplemental materials) in L2 courses. Ranalli (2008) replicated Miller and Hegelheimer’s (2006) research findings and also investigated whether structured play of The Sims, combined with specially designed support materials, could allow L2 learners of English not only to use the game but also to enhance their grammar and vocabulary knowledge. Rankin et al. (2006) utilized the massive multiplayer online role-playing game (MMORPG), “Ever Quest 2”, with a second language methodology to create an immersive virtual learning environment for second language acquisition (SLA). Cobb and Horst (2011) employed a video game for ESL vocabulary learning, “My Word Coach”, for the Nintendo DS or Wii, distributed commercially since late 2007.

Summarizing the literature, we find following research issues in the game-based language learning field: 1) There are only a few studies that utilize games for L2 vocabulary acquisition, 2) Most of current studies focus on using existing commercial games, which were originally created for entertainment and lack capability for vocabulary learning pedagogy, and 3) Most of the games used in language research are role-playing games (RPG) and they must be played at fixed locations (by video game console, TV, or computer).

This study describes a mobile learning companion game, named “MyEVA (My English Vocabulary Assistant) Mobile”, which was originally developed by combining the metacognitive and cognitive strategies and mobile gaming technologies. Different from the RPG games utilized by current body of research on game-based language learning, MyEVA Mobile has only a central virtual character, EVA
(English Vocabulary Assistant), who is capable of providing students with individual and useful information and helping them pass different vocabulary learning tasks. After completing different learning tasks and tests, the students can obtain virtual currency to buy variant items to dress up their EVA, or send virtual currency and items to their friends. We expect our game design of mobile learning companion to be helpful in developing a closer relationship between the students and the learning companion, which will further contribute to sustaining the students’ participatory motivation. As a result, the gameplay will systematically help the students expand their L2 vocabulary.

2. System Modeling

In this study, we are developing a systematic approach to model MyEVA Mobile, called the Metacognitive and Cognitive Model of Interactivity (MCMI), as shown in the Figure 1. The MCMI describes the connection between metacognitive and cognitive processes, the types of interactivity, and the skills the students are expected to develop using MyEVA Mobile. The MCMI provides (1) A framework the developers should refer to, and (2) Interprets the users’ behaviors in MyEVA Mobile. The MCMI will be useful when the researchers utilize EDM (Education Data Mining) techniques to identify the behavior patterns in MyEVA Mobile.

The MCMI is comprised of two types of interactivity that the users engage in while playing MyEVA Mobile: (1) **Game Playing**, i.e., purchasing items to enhance the EVA, and (2) **Solving Tasks**, i.e., solving different learning tasks to earn virtual currency and game experience. When the users play the game, they are expected to engage in two processes: (A) **Item Information Seeking**, i.e., finding a favorite item and acquiring its price, and (B) **Find Solutions to Obtain Items**, i.e., understanding the game rules and knowing how to obtain the items. (1) and (2) together represent the metacognitive strategies linked to Learning Companion Construction. To successfully execute metacognitive strategies, for which the users should correctly execute related cognitive processes. Searching Shopping Mall, for instance, represents a cognitive strategy the users can employ to obtain the item information; Shopping Mall Interface is a system function provided in MyEVA Mobile for the users to execute the cognitive strategy of Searching Shopping Mall.

![Figure 1. The Metacognitive and Cognitive Model of Interactivity](image)

3. MyEVA Mobile

According to the MCMI, we developed MyEVA Mobile with five major functions: Vocabulary Learning & Review, Learning Task, Shopping Mall, Game Profile, and Game Ranks. System screenshots are shown in Figure 2. MyEVA has two main types of interactivity: **Game Playing** and **Solving Tasks**. The game design of MyEVA Mobile centralizes on dressing the user’s virtual learning companion with various featured items, acquired by paying with virtual currency. The virtual currency of game can be obtained through completing different tasks in MyEVA Mobile. The *task* is the central...
learning activity in MyEVA Mobile, requiring students to learn a number of words and pass a vocabulary proficiency test within the game. During a learning task, MyEVA Mobile provides six cognitive-oriented vocabulary learning strategies (VLS) to help students improve their vocabulary knowledge: Word Card Strategy, Flash Card Strategy, Imagery Strategy, Synonym strategy, Antonym strategy, and Example Sentence Strategy. The function of the Shopping Mall is the most charming characteristic of the game play. “Buying favorite items” will motivate the students to engage in solving different learning tasks to obtain more virtual currency. MyEVA Mobile provides over 300 items in the Shopping Mall. When the students identify their favorite items, they can purchase them for their EVAs, and the portrait of EVA will change instantly in the social community of MyEVA Mobile.

Figure 2. (A) Main interface (B) Shopping Mall interface (C) Learning Task interface

4. Conclusion and Future Work

This study describes a mobile learning companion game which is under on-going development, called MyEVA Mobile, which acts as a companion to the students during learning activities. In the current status of this study, development of the system has been completed. In the future, we aim to explore two research questions: (1) How does MyEVA Mobile improve the ESL students’ L2 vocabulary acquisition? (2) How does MyEVA Mobile affect the ESL students’ perceptions of learning, flow, and enjoyment in the game? A mixed research with vocabulary proficiency pre- and post-tests; a questionnaire survey of perceived learning, flow, and engagement (Barzilai & Blau, 2014); and EDM techniques will be conducted to explore the effectiveness and behavior patterns of MyEVA Mobile. The experimental results of this study are expected to provide insights for language teachers, curriculum designers, and, in particular, system developers of mobile-assisted language learning.

Acknowledgements

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References

Online Peer Feedback and Learner Autonomy in EFL Writing Class

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Abstract: The information and communication technology has been utilized by most universities in Indonesia though it is rarely integrated in teaching and learning activities in classes. This paper, as part of a study to foster learner autonomy using technology based approach, investigated the roles of online peer feedback toward learner autonomy development. The data used in this study involved students’ interview transcriptions. The results showed that online peer feedback has facilitated students’ metacognitive strategies and enhanced their motivation to learn writing.

Keywords: learner autonomy, online peer feedback, metacognitive strategies

1. Introduction

One of the prominent issues in the theory and practice of language teaching recently is the importance of facilitating students to foster autonomy in their learning (Benson, 2011). It is in line with the goal of Indonesian national education agenda, which puts learner autonomy as a part of its higher education goals (Indonesian National Education Law 2012). Benson (2011) suggested that one of the approaches to foster autonomy is technology based approach. This paper is part of a study to foster learner autonomy in EFL writing class using technology approach that focuses on the roles of online peer feedback toward learner autonomy development.

2. Literature review

As the aim of the study is to investigate the roles of online peer feedback on fostering learner autonomy, the areas of literature discussed in this section cover learner autonomy and online peer feedback.

2.1 Learner autonomy

Autonomy has been broadly defined by Benson (2011) as “the capacity to take control over one’s own learning”. This definition becomes the basis of this study since the construct of ‘control’ is open to empirical investigation. Dimensions of control suggested by Benson involve control over learning management, control over cognitive processes and control over learning content. As the forms that learner autonomy takes differ according to the person and the context, an autonomous learner then is described as someone whose learning has some of those components, but not necessarily all of them (Benson, 2011).

Reinders (2010) emphasises autonomy as a process and distinguishes a number of phases in the process that start with awareness raising. A useful concept of learner autonomy development in language classroom context involves four phases; defining tasks, setting goals and planning, enacting study tactics and strategies, and metacognitively adapting studying (Reinders, 2010). Since learning in classroom context involves social aspect, “autonomy thus includes the notion of interdependence, that is being responsible for one’s own conduct in the social context: being able to cooperate with others and solve conflicts in constructive ways” (Kohonen, 1992). This implies the importance of collaboration in developing learner autonomy.
2.2 Online Peer feedback

Peer feedback is defined as “a communication process through which learners enter into dialogues related to performance and standards” (Liu and Carless, 2006). Hyland and Hyland (2001) mentioned three functions of feedback which are praise, criticism and suggestion. During the peer feedback activities, students may receive appreciation, or they might be criticized. Furthermore, students may receive suggestions for improving their works.

In this study, online peer feedback refers to peer feedback activities that are done online by making use of blog or weblog as the online medium. A blog is “a web application that displays serial entries, asynchronously developed, by employing simple user interfaces and allowing users to easily maintain content or add new dated entries, with the advantages of inserting graphics, multimedia, video and audio, not to mention the text, which is an important aspect of blogging” (Wei, 2010; Meyer, 2010; Lai & Chen, 2010; Deng & Yuen, 2011; Fageeh 2011). One of the characteristics of blog is that it enables self-publishing that encourages ownership on its contents (Jones, 2006).

3. Methodology

The study involved 16 students of English Education Graduate School at University of Muhammadiyah Prof. Dr. HAMKA, enrolling academic writing class in the first semester of 2013. During the semester, students completed 3 writing assignments. Each assignment involved posting the writing draft on their blog, peer feedback activities, making the revision and posting the final draft. Among those 16 students, five were chosen to take part in the in-depth interviews. Semi-structured interviews were applied to reveal students’ perceptions toward the roles of the online peer feedback on fostering learner autonomy. Semi-structured interviews can be a meaningful way to generate data by talking interactively with people, asking them questions, listening to them, gaining access to their accounts and articulation or analysing their use of language and construction of discourse (Mason 2002).

4. Findings and discussions

The findings of the study discussed in this paper are restricted to metacognitive strategy and motivation as two of important aspects in fostering learner autonomy.

4.2.1 Metacognitive strategy

Even though the word strategy was not used explicitly, metacognitive strategies emerged as prominent themes from the analysis of students’ interviews. According to O’Malley and Chamot (1990), the metacognitive strategies involve ‘thinking about the learning process, planning for learning, monitoring the learning tasks, and evaluating how well one has learned’. These strategies are the potential components of learner autonomy because “they are concerned with control over learning management”, a dimension of control over learning that an autonomous learner needs to have (Benson, 2011).

Giving feedback on others’ works has guided students to understand the writing aspects they need to learn more. They realized that in order to give constructive feedback, they had to understand well the aspects of writing they commented on. Regarding the feedback they received from others, they believed that others could be better in looking at the mistakes they made, that they themselves might not be aware of. The peer feedback has raised their awareness of their weaknesses and enabled them to concentrate on the areas of writing they need to improve. Moreover, the feedback has given them direction to plan further learning for a better achievement in the future.

4.2.2 Motivation

The effort to foster learner autonomy cannot be separated from enhancing students’ motivation since motivation is the pre-condition for autonomy (Jiménez Raya et al., 2007). In the study, students
perceived that publishing their works to the public by making use of blog as the online medium was a motivating factor for them in the academic writing class. This finding is relevant to a study conducted by Jones (2006), revealing that publishing for an authentic audience motivated the students’ writing and interaction. Among motivation components in the learning situation suggested by Dornyei (1994a), *intrinsic interest* and *satisfaction* in the outcome of an activity have emerged in the study. Students felt satisfied with their progress and the learning process occurred there. People could see how their writings had improved because the blog enables their progress to be documented from time to time. The praises they received from their friends about their works had raised the feeling of satisfaction as well. Furthermore, the choice of Wordpress as the blog site to publish their writings and do the peer comments became an interesting part for the students especially those who like designing a lot. The blog site offered them advantages of features and space to create a blog design as they like.

5. Conclusions

This paper, as part of a study to foster learner autonomy in academic writing class, was aimed to reveal the roles of online peer feedback toward learner autonomy development. Results of the study showed that the online peer feedback has supported students in facilitating their metacognitive strategies and raised their motivation to learn writing.

Acknowledgements

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References


Survey on Japanese University Students’ Learning Experiences with ICT and Open Sources for International Collaboration

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Abstract: The purpose of this research is to report university students’ learning experiences with information communication technology (ICT) and open educational sources (OES) for global learning in Japan. The survey of 327 Japanese university students included seven multiple-choice items and 16 open-ended questions about students’ learning experiences. The results showed that the most frequent use of ICT, including computer-mediated communication, is a discussion function of Blackboard for formal collaborative learning and LINE for informal learning. Learning with OES is less popular; only one student had taken a two-month course via YouTube provided by a Japanese university, and only two students had learned with foreign students online. The students’ preferred activities for future international collaborative learning included project-based learning, casual chats and conversation, discussion, and e-mail exchange. Favored topics were ones related to their majors, international situations, the environment, cultural differences, and school life. Language proficiency, communication, cultural differences, and values and beliefs caused the most anxiety and concern for international collaboration, but the time gap, legal issues, and infrastructure were also considered.

Keywords: global learning, information and communication technology (ICT), computer mediated communication (CMC), open educational sources (OES)

1. Introduction

The globalization of society requires Japanese university students to acquire skills to communicate and work collaboratively and creatively with foreigners. Efforts to promote the internationalization and global human development of university education are strongly encouraged in Japan (Central Council for Education, 2010). Information Communication Technology (ICT) and Open Educational Sources (OES) allow people to learn at their own pace and communicate with each other without the restriction of time and space and in turn enable us to provide more global learning opportunities for our students. The use of ICT in collaborative learning among multiple nationalities in Japan has been documented (e.g., Sugiyama et al., 2005) but is uncommon and not yet a tool provided by many universities.

The goal of our research project is to design and develop a support system for international collaborative learning for learners as active learners and for teachers as facilitators. To attain this goal, we investigate the current problems for international collaboration via ICT in Japan, especially from the students’ perspectives. Students’ responses to the researcher-designed questionnaire focus on the use of ICT for both formal and informal learning, use of OES, the collaborative learning experience with foreign students, preferred activities, and topics for future international collaboration.

2. Research Method

The survey-type research method was employed in this study. Three hundred sixty-nine students registered to four computer-assisted language learning courses were asked to participate in the survey.
The students were all sophomores at a national university in Japan and were registered in the departments of Pharmacy, Social Environment, Information Technology, and Mechanical Engineering. Excluding Pharmacy, the students’ English proficiency level was at the university average (444 to 480), with TOEIC-IP score averages from 412 to 450 over the last five years. Students in Pharmacy had scores averaging from 465 to 525 over the last five years, which was slightly above the university mean.

The researcher-designed questionnaire was used to collect the data in this study. The survey consisted of seven multiple-choice items and 16 open-ended questions about students’ learning experiences and was divided into three main sections: frequency of ICT use for formal and informal collaborative learning, OES, and learning experiences and opinions for international collaborative learning. The questionnaire was conducted with an assessment function of Blackboard, a learning management system, in one of the computer assisted language learning (CALL) classes during the first semester. The CALL classroom was equipped with one computer per student, and the students responded to the questionnaire via their assigned computer for about fifteen minutes.

The data collected were analyzed descriptively per section. For ICT use in collaborative learning, graphs were created to compare ICT applications used by the students. The responses of the last two questions related to future international collaborative learning and were organized with KJ methods.

3. Results

The results on the frequency of ICT use for formal collaborative learning are shown in Figure 1. There were ten alternatives in the multiple-choice question; Mixi, Facebook, Twitter, Google+, Wiki, Cybozu, LINE, ChatWork, Blackboard, Moodle, and Other. The number and percentages above the bars in the figure indicate the number and percentage (of total) of students who selected the targeted alternative. Blackboard was reported as the most frequently used ICT technology for collaborative learning in a formal educational setting. Google+, Wiki, LINE, and Moodle were among the group in the second most frequently used (21.71% to 27.22%). Figure 2 illustrates the frequency of ICT use for informal collaborative learning. LINE (n = 299, 91.44%) was the most frequently used, followed by Twitter (n = 210, 64.22%) and then Facebook (n = 155, 47.40%). In contrast to the formal setting results, Blackboard and Moodle were less popular in informal settings. Skype, Viper, Pinger, and Yahoo Answers were included as “Other.”

As learning experiences with OES, only one student out of 327 students (0.31%) responded as having experience with open educational sources for learning. Over a two-month period, this student had studied the course content, which was provided by one of the best universities in Japan. He considered the course to be challenging but interesting. Related to learning experience from international collaboration, only two students (0.61%) answered “yes” regarding collaborative learning experiences with foreign students via ICT and CMC. Student A had had conferences with Skype for three years during middle education. He discussed some topics with foreign students over Skype. A positive point of the activity was that he could communicate with foreign students.
face-to-face via Skype, while the negative points included the difficulty in time management because of the time gap and summer time. Student B had a school trip to New Zealand during high school. In order to prepare for this trip, he exchanged mail with the foreign students who were assigned to his group. He reflected on his learning experience as an enjoyable learning activity.

Table 1 summarizes the results of preferences and expectations for future international collaborative learning, and Table 2 organizes the results related to anxieties and concerns. The students’ preferred activities for future international collaborative learning included project-based learning, casual chat and conversation, discussion, and e-mail exchange. Their favorite topics were ones related to their majors, international situations, the environment, cultural differences, and school life. Language proficiency, communication, cultural differences, and values and beliefs were reported as anxieties and concerns for international collaboration, and time gap, legal issues, and infrastructure were also considered.

Table 1: Students’ Preferences and Expectations for Future International Collaborative Learning

<table>
<thead>
<tr>
<th>Categories</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td></td>
</tr>
<tr>
<td>Conversation &amp; Chat</td>
<td>28</td>
</tr>
<tr>
<td>Project</td>
<td>25</td>
</tr>
<tr>
<td>Creation and Manufacturing</td>
<td>13</td>
</tr>
<tr>
<td>Group Discussion</td>
<td>2</td>
</tr>
<tr>
<td>Mail Exchange</td>
<td>1</td>
</tr>
<tr>
<td>Research</td>
<td>1</td>
</tr>
<tr>
<td>Topics</td>
<td></td>
</tr>
<tr>
<td>Specialty</td>
<td>25</td>
</tr>
<tr>
<td>Environment</td>
<td>14</td>
</tr>
<tr>
<td>International Issues and Trends</td>
<td>12</td>
</tr>
<tr>
<td>Language/ English Learning</td>
<td>7</td>
</tr>
<tr>
<td>Value Difference</td>
<td>2</td>
</tr>
<tr>
<td>Hobby</td>
<td>1</td>
</tr>
<tr>
<td>Human Rights</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td>16</td>
</tr>
<tr>
<td>No Preferences</td>
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<tr>
<td>Negative Attitudes toward</td>
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</tr>
<tr>
<td>International Collaborative</td>
<td></td>
</tr>
<tr>
<td>Learning</td>
<td></td>
</tr>
<tr>
<td>No Response</td>
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</tbody>
</table>

Table 2: Anxiety for Future International Collaborative Learning

<table>
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<th>Categories</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Language Proficiency</td>
<td>153</td>
</tr>
<tr>
<td>Communication</td>
<td>64</td>
</tr>
<tr>
<td>Culture Differences</td>
<td>15</td>
</tr>
<tr>
<td>Time Gap</td>
<td>8</td>
</tr>
<tr>
<td>Nonverbal</td>
<td>5</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>Value Difference</td>
<td>5</td>
</tr>
<tr>
<td>Legal Issues</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>11</td>
</tr>
<tr>
<td>No Anxiety</td>
<td>11</td>
</tr>
<tr>
<td>Cannot Imagine and Don’t Know</td>
<td>7</td>
</tr>
<tr>
<td>Negative Attitudes toward</td>
<td>4</td>
</tr>
<tr>
<td>International Collaborative</td>
<td></td>
</tr>
<tr>
<td>Learning</td>
<td></td>
</tr>
<tr>
<td>No Response</td>
<td>66</td>
</tr>
</tbody>
</table>

4. Discussion and Future Research

The survey revealed that not many students had opportunities to learn with foreign students via ICT. Only one student had used OES to study one university course via YouTube. The results highlight the crucial need of Japanese universities to provide more meaningful opportunities for university students to collaboratively learn with foreign students. In order to design a course and activities for international collaborative learning, the students’ preferences and concerns, as documented in this research, should be considered to implement a feasible, sustainable, and learner-centered collaborative learning experience. Similarly, in the design of facilitation for collaborative learning activities, students’ needs are significant and should be considered based on the results of this research.

In future research, not only students’ expectation and concerns but also those of teachers and stakeholders should be considered. This fundamental survey should also be implemented in other countries to examine cultural differences. Through several pilot and experimental projects, we would like to develop and improve a facilitation model for multiple foreign teachers dispersed in different places.

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References
Teacher Learning in a Virtual Field Experience

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Abstract: This study aims to explore how teaching assistants (TAs) respond to students’ written texts through a virtual field experience. Five prospective teachers served as TAs to revise 20 college student writers’ texts in the English as a Foreign Language (EFL) context in an online virtual field experience. This study draws on the notions of hard and soft scaffolds to conceptualize the way TAs provide and reflect on their written support. It was found that TAs’ preconceptions of effective scaffolding in text revision were challenged and reexamined. An online virtual field experience nurtured teacher learning with efficient support.

Keywords: Teacher Learning, Teaching Assistants, Virtual field experience

1. Introduction

This study draws on the notions of hard and soft scaffolds (Brush & Saye, 2002; Saye & Brush, 2002) to theorize support and assistance that teachers provide to develop students’ writing skills. Saye and Brush (2002) advocate that the nature of scaffolds should be individualized. It can be referred to as a number of instructional strategies to facilitate learning processes. Useful scaffolding is used to bridge the gap between what learners can achieve by themselves and what they can achieve with the aid of capable actors such as teachers, adults, or peers (Beed, Hawkins, & Roller, 1991; Raymond, 2000; Rogoff, 1990; Vygotsky, 1978). The capable actors must tap into learners’ actual developmental levels at first and then provide the support slightly beyond the learners’ current level so as to make the instruction more accessible to learners. Scaffolding can then be withdrawn when learners gain the competence over their learning (Beed, Hawkins, & Roller, 1991). The ultimate goal of scaffolding is to develop students to be autonomous learners who can apply what they’ve learned previously to accomplish similar tasks on their own (Rogoff & Gardener, 1984). Along the same line, teacher written feedback scaffolds students to become independent writers through raising their awareness of grammar usages and writing conventions.

To address effective scaffolds that support both teaching and learning, Brush and Saye (2002) reconceptualize scaffolding as soft and hard scaffolds. Soft scaffolds are defined as “dynamic, situation-specific aid provided by a teacher or peer to help with the learning process” (Brush & Saye, 2002, p. 2). This form of support requires teachers to assess students’ current level of writing ability and meet their immediate learning needs (Saye & Brush, 2002). Rather than a one-size-fits-all strategy, soft scaffolds focus on support at one particular moment in time: teachers ask for clarification, request information, and correct grammatical mistakes throughout the student writing process.

Hard scaffolds refer to the “static support that can be anticipated and planned in advance based upon typical student difficulties with a task” (Brush & Saye, 2002, p. 2). This assistance is framed ahead when teachers have identified student writers’ difficulties and types of effective comments as opposed to randomly underlining every word and sentence. In this present research, TAs analyzed both students’
revised drafts and evaluations to explore their feedback practice and change. The virtual field experience assists prospective teachers to transform their personal beliefs, knowledge, and experience in scaffolding to facilitate actual learning (Pence & Macgillivray, 2007). When TAs identify gaps between their teaching assumptions and current students’ needs, hard scaffolds can be forged to develop new understandings of written support.

In this study, an online writing system is developed to provide the virtual field experience for prospective teachers to serve as teaching assistants (TAs) who scaffolded students through multiple writing stages. In this study, student writers (SWs) were required to write an essay and posted it online for TAs to comment on. After student writers posted their first drafts, TAs were arranged to correct and respond to students’ essays. Student writers were encouraged to evaluate how helpful TAs’ corrections and comments were and rated them based upon a 5-point scale. Finally, each student writer revised his/her original essay according to TAs’ suggestions and reposted it. TAs used student writers’ evaluation to examine the effectiveness of their scaffolding.

According to the retrospective interviews, five TAs all appreciated the virtual field experience in which their preconceptions of effective scaffolding in text revision were challenged and reexamined. The TAs’ reinterpretations of their scaffolding resulted from their observations on the student writers’ revision process and evaluations on the TAs’ comments and corrections. By observing student writers’ revision process, the TAs evaluated whether their corrections and comments could effectively scaffold student writers to revise their texts. From the students’ evaluations, the TAs could check whether student writers encountered difficulty in understanding the TAs’ comments and corrections. The TAs started to think as student writers to explore the reasons why their student writers could not benefit from their scaffolding and what scaffolding student writers really needed in the revision process. If TAs were not provided with the opportunity to reexamine the effectiveness of the scaffolding by checking students’ responses and revised texts, they could never recognize the importance of guiding students to think independently, analyze students’ language proficiency levels, and encourage students to express personal viewpoints and voices in their reaction essays.

Through ongoing reciprocal examinations of their prior and new preconceptions of scaffolding, prospective teachers learn to develop as professionals (Freeman & Johnson, 1998; Ritchie & Wilson, 2000). Particularly, online learning environment conceals the student participants’ identities, so their perceptions of feedback usefulness may be more candid in helping TAs reflect on their commentary behaviors and further examine their teaching assumptions and current student’s needs. The students’ revised texts and their feedback evaluation provide opportunities for TAs to identify soft scaffolds—situated support and pedagogical intervention that the student writers need. More importantly, the online feedback submission promotes interactions between the students and TAs who dialogue what constitutes effective feedback. Then, TAs can draw upon these inputs to formulate their hard scaffolds—pre-planned instructions by anticipating learners’ difficulties and challenges (Brush & Saye, 2002; Saye & Brush, 2002). When the TAs found that they should identify their students’ background knowledge and select common errors, these types of assistances could specifically tap into learning-to-write processes and become TAs’ pedagogical knowledge.

 Appropriately developed computer-mediated tools increase opportunities to achieve instructional goals. As the purpose of teacher feedback is to help students become independent writers and improve their writing skills (Hyland & Hyland, 2006), future research can include in what way in-service teachers experience online feedback practice and examine similarities and differences between traditional and computer-assisted approaches. The effect of feedback provided in different teaching and learning environments on student writing can be also addressed in further studies.

Acknowledgement

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References


The Relationships among Learners’ Backgrounds, Metacognitive Vocabulary Learning Strategy Awareness and Mobile Vocabulary Learning Readiness

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Abstract: The present study aims to investigate the relationship between the metacognitive vocabulary learning strategy awareness and the mobile vocabulary learning readiness among Taiwanese junior high school EFL students. A total of 372 participants completed a questionnaire which assessed their readiness towards mobile vocabulary learning. They also completed the Metacognitive Vocabulary Learning Strategy Awareness Questionnaire, which evaluated their awareness and perceived use of vocabulary learning strategies. The results indicated that the learners’ proficiency levels and ownership duration significantly influenced their readiness towards mobile vocabulary learning and metacognitive vocabulary learning strategy awareness. In addition, a significant correlation between the learners’ readiness and awareness was found.

Keywords: m-learning, metacognitive vocabulary learning strategy awareness, mobile vocabulary learning readiness

1. Introduction

Learners, with the help of metacognition knowledge, can choose relevant technological devices for learning and use effective strategies to facilitate achieving learning goals (Bannert, Hildebrand & Mengelkamp, 2009). In such technology-enhanced environments, successful learners especially need metacognition to identify the differences among available technological tools (Antonietti, Colombo & Lozotsev, 2008). The awareness of metacognitive strategy use may also have effects on success of learning with technology; and, metacognitive instruction should be incorporated in e-learning (Kramarski & Zeichner, 2001); and, instructors should evaluate learners’ metacognition, analyze their status of metacognitive knowledge and intervene to help them become more aware of their use of metacognitive strategies (Oxford, 2002; Stadtler & Bromme, 2008). As Miangah and Nezarat (2012) point out, vocabulary learning is one of the most commonly discussed areas of mobile-assisted language learning (MALL). In the present study, we intend to first explore whether the various backgrounds of Taiwanese junior high school EFL students would influence their awareness of metacognitive vocabulary learning strategies and their readiness towards mobile-assisted vocabulary learning. The relationship between the aforementioned awareness and readiness was analyzed and discussed.

2. Methods

2.1 Participants

A number of 372 copies of questionnaires completed by the students from the four districts of a metropolitan area in Taiwan were collected and analyzed in the present study.
2.2 The Instruments

The questionnaire comprised three sections. The first section was designed to elicit the demographic information of grades, sex, proficiency levels and duration of ownership. Section two assessed their readiness towards using smartphones to learn English vocabulary and included familiarity, attitude and experience. The awareness and perceived use of metacognitive vocabulary learning strategies, including selective attention, self-initiation and consolidation, were then assessed in the last section.

3. Results and Findings

3.1 Descriptive Statistics

The participants’ means, standard deviations and the results of the tests of significance of the readiness in general and the three components (test value = 3) are listed in Table 1 and those of the metacognitive awareness in general and the three components (test value = 3) are listed in Table 2.

Table 1: Descriptive statistics and t-tests of readiness and its components (N = 372).

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean (Average per item)</th>
<th>SD</th>
<th>t</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readiness</td>
<td>3.3343</td>
<td>.57406</td>
<td>11.232</td>
<td>.000</td>
</tr>
<tr>
<td>Familiarity</td>
<td>3.1871</td>
<td>.77261</td>
<td>4.671</td>
<td>.000</td>
</tr>
<tr>
<td>Attitude</td>
<td>3.3118</td>
<td>.73611</td>
<td>8.170</td>
<td>.000</td>
</tr>
<tr>
<td>Experience</td>
<td>3.5040</td>
<td>.49441</td>
<td>19.663</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 2: Descriptive statistics and t-tests of metacognitive awareness and its components (N = 372).

<table>
<thead>
<tr>
<th>Component</th>
<th>Mean (Average per item)</th>
<th>SD</th>
<th>t</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MetacognitiveAwareness</td>
<td>3.5367</td>
<td>.90982</td>
<td>11.378</td>
<td>.000</td>
</tr>
<tr>
<td>Selective Attention</td>
<td>3.5493</td>
<td>1.08426</td>
<td>9.771</td>
<td>.000</td>
</tr>
<tr>
<td>Self-Initiation</td>
<td>3.9151</td>
<td>.91144</td>
<td>19.364</td>
<td>.000</td>
</tr>
<tr>
<td>Consolidation</td>
<td>3.1458</td>
<td>1.02877</td>
<td>2.734</td>
<td>.000</td>
</tr>
</tbody>
</table>

3.2 The Relationships among Demographic Variables and Mobile Vocabulary Learning Readiness

In order to investigate the relationships among the demographic variables and the components of mobile readiness, t-tests and one-way ANOVA were conducted. According to the results of ANOVA, the differences between the learners’ grades in regard to Familiarity and Attitude were not significant. Nevertheless, the learners in 9th grade might have more experiences in mobile vocabulary learning than the 7th graders did. The results of sex revealed that the differences between male and female learners were insignificant. With respect to the levels, the results showed that those who had passed the intermediate level or higher had better readiness than the learners who had only passed the elementary level. In terms of the duration of ownership, the learners owning and using smartphones for more than 1 year surpassed the other learners in all the three components. Those who had been using smartphones less than 6 months fell behind the other two groups of learners in regard to their readiness.

3.3 The Relationships among Demographic Variables and Metacognitive Vocabulary Learning Strategy Awareness

The results of ANOVA showed that the differences among the learners of different current grade levels were insignificant in terms of Selective Attention and Self-Initiation. The 9th graders were more aware of their Consolidation strategy use than 8th graders. As for the learners’ sex, the results again were insignificant. In terms of proficiency levels, the learners who had passed the GEPT tests outperformed those who had not passed any of the tests. The results showed that those who had passed the
intermediate level or higher had better awareness than the learners who had only passed the elementary level. When the duration of ownership is concerned, the learners owning and using smartphones for more than 1 year surpassed the other learners in all the three components. Those who had been using smartphones less than 6 months fell behind the other two groups of learners.

3.4 Predictors of Readiness towards Mobile Vocabulary Learning

The inter-correlation of the variables is presented in Table 3.

Table 3: Inter-correlation among variables.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Readiness</td>
<td>1.000</td>
<td>.827**</td>
<td>.775**</td>
<td>.808**</td>
</tr>
<tr>
<td>2. Selective Attention</td>
<td>1.000</td>
<td>.722**</td>
<td>1.000</td>
<td>.695**</td>
</tr>
<tr>
<td>3. Self-Initiation</td>
<td></td>
<td></td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>4. Consolidation</td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01.

The multiple correlation coefficient ($R$) was found to be .892 and the coefficient of determination ($R^2$) was .796. The three types of metacognitive vocabulary learning strategy awareness could explain 79.6% of the variance of the criterion variable, meaning the three variables predicted 79.6% of the mobile vocabulary learning readiness. As for the coefficients, it was found that Selective Attention ($t = 9.964, p = .000$), Self-Initiation ($t = 7.159, p = .000$) and Consolidation ($t = 9.119, p = .000$) were significant predictors of readiness towards mobile vocabulary learning. The most significant predictor of the readiness towards mobile vocabulary learning was Selective Attention; the second is Consolidation; and Self-Initiation had the least effect to predict or explain the variance. The equation for the standardized multiple regression model is: Learners’ readiness towards mobile vocabulary learning = .387 × Selective Attention + .341 × Consolidation + .259 × Self-Initiation.

In sum, the learners’ grades, proficiency levels and their ownership duration were found to have significant influences on their awareness of metacognitive strategy use and readiness towards mobile learning. Furthermore, the learners’ metacognitive vocabulary learning strategy awareness was found to be positively and significantly related to their mobile vocabulary learning readiness and the three components of metacognitive strategy awareness were strong predictors of the learners’ readiness towards mobile vocabulary learning. The present study suggests that educators and instructors take learners’ proficiency levels and ownership duration into consideration before designing and integrating mobile technologies into language curricula.

References


Abstract

Immersed as they are in technology today, educators have more options to create a curriculum using the most-advanced and convenient means in their classrooms. Teachers of English as a foreign language can now utilize technology-enhanced communication to connect their students to other English learners in different countries and cultures. With the widespread of instant messaging system and the increasingly easy access to hand-held devices such as cell phones and tablet computers, English learners worldwide can experience authentic cross-cultural communication for language and cultural learning. This paper argued that using popular mobile software and incorporating cross-cultural learning in an instructional design of a language learning course can increase learner motivation for cross-cultural communication, whereas the cross-cultural learning context can lead to willingness to communicate in an international context. In order to examine the willingness to communicate cross-culturally of English learners, a culturally oriented, collaborative language-learning project integrating mobile mediating technology was implemented on university students of two cultural groups. Data were collected for quantitative analysis in order to explore participants’ willingness to communicate cross-culturally based on the utility of LINE and the cross-cultural learning context. Results showed that both the use of LINE and the effectiveness of cross-cultural collaboration gained from the instructional design had significantly predicted these learners’ future willingness to communicate in an international context.

Keywords: LINE, mediating technologies, m-learning, willingness to communicate, cross-cultural

Introduction

The purpose of English teaching and learning in non-native English speaking countries shall consider 21st century globalizing context particularly in an environment shaped by mediating communication technology development. Steering away from the traditional focuses of grammar, reading and translation, English as foreign language should be taught based on a combination of fostering intercultural awareness with authentic environment using the language learned. Raising cultural awareness, promoting intercultural communicative effectiveness, and incorporating online technologies in higher education curriculum are becoming prevalent since these strategies are believed to be beneficial to students’ future career in the workplace (Fitzpatrick & O’Dowd, 2012). Technology closed the gap of boarders of physical geographical presence and brought people with more opportunities to communicate across cultures. Currently more focuses are placed on mobile technology, as the portability of mobile devices makes learning easy.

This study examined the effect on students’ future willingness to communicate in intercultural context, from a cross-cultural, language learning instructional design via the popular mobile phone application software, LINE, between Taiwanese and Japanese college students. The researchers propose that the online collaboration influenced by the partnership and efficiency of Instant Message enabled via LINE will increase students’ willingness to engage in communication in cross-cultural context in an effective
Design and instrument

Japan and Taiwan has one hour time difference which work as an advantage in this research design for authentic communication. Using the application, LINE, students were assigned 3 guided questions embedded with cultures and personal believes. Participants exchanged information using Instant Messaging and actual verbal correspondence via LINE are media for communication between students of two cultural groups for 4 weeks. In the final week students had to hand in individual report to their instructors respectively. One of the reasons the researchers selected LINE is that a certain amount of familiarity with mobile devices on the part of learners will increase the effectiveness of mobile communication, as the difficulty of using a new tool may possibly hinder their willingness to communicate (Hockly 2013).

Methodology

In order to statistically investigate how the effectiveness an instrumental design incorporating cross-cultural English learning in mobile communicative context can impact learners' future willingness to communicate in an international context, stepwise multiple regression analysis was conducted, with “future willingness to communicate in an international context” as the dependent variable, and “the use of LINE” and student's perception of “the effectiveness of the cross-cultural English learning activity” as independent variables.

Participants

In fall semester of 2013, a total of sixty 2nd year university students of non-English majors were selected according to their English level and accessibility to mobile device. Thirty Japanese and thirty Taiwanese students were randomly assigned to pairs as a team for collaborative learning. Each group contained 6 students, with 3 from each cultural group. Students’ English level was determined by a pre-test of English designed by the researchers.

The measures

We used a survey to investigate possible factors influencing student future willingness to communicate in an international context. This study had used a self-created survey that includes three measures.

Future willingness to communicate cross-culturally measurement consisted of four items. These items were adopted from and revised part of Yashima’s (2002) question items measuring “Intercultural friendship Orientation in English Learning” within the L2 Willingness to Communicate (WTC) structure, to indicate future willingness in an international context. These items were used to measure if students have interest in communicating with people of different cultural backgrounds. Cronbach Alpha coefficient was .85, indicating a high reliability. Ratings for the 5 items were averaged as a continuous scale for future willingness to communicate cross-culturally.

Cross-cultural cooperative learning effectiveness measurement consisted of four items. These items were adopted from and revised part of Koh & Hill’s (2009) measurement on student satisfaction toward an online group work to indicate the feeling of success in a cooperative learning environment. Cronbach Alpha coefficient was .86, indicating a high reliability. Ratings for the 5 items were averaged as a
Using mobile application software measurement consisted of five items. These items were self-created based on several recent studies. These items were used to measure participant’s satisfaction using LINE as a mediating tool for cross-cultural cooperative learning. The first two items in the measurement asked participants to self-report their digital literacy about using LINE for communication. The following two questions asked students to self-evaluate their satisfaction toward using LINE for cross-cultural learning. The last item was a global question measuring overall mental effort for the synchronous mobile mediating communication context. Alpha coefficient was .78. Ratings for the 5 items were averaged as a continuous scale for using mobile application software as tool.

Result and Analysis

“Cross-cultural collaboration effectiveness” and “using mobile application software” had significantly predicted the variance in “future willingness to communicate in an international context.” \( F(2,30) = 24.512, p = .000*** \). The two variables together account for about 62% of the variance. The figure shows that the fitting is very appropriate. Additionally, beta value had shown significant influences that the two predictor variables influence “future willingness to communicate cross-cultural,” with “cross-cultural collaboration effectiveness” variable showing beta value .599 (\( \beta = .599, p < .00 \)) and “using mobile application software” showing beta value (\( \beta = .279, p < .05 \)). The result shows that students’ future willingness to communicate in an international context is affected by their perception of an effective collaboration from an instructional designed in cultural context and the use of popular mobile mediating software, with learning effectiveness showing higher influence than the use of popular mobile software.

Conclusion

Communication in an international context is becoming a pervasive truth in the globalized world. The teaching and learning of language in higher education should reflect this fact. This study suggests to integrate online technologies and cross-cultural issue in EFL classes to prepare students for future workplace. The researchers proposed to use popular mobile mediating software to increase students’ motivation engaged in international context. The results of this study indicated that the use of LINE had successfully increased student willingness to communicate cross culturally in the future, as statistic result showed that both an effective cooperative learning experience between partners of different cultural groups, and the experience of synchronous communication using LINE, can successfully predict learners’ future willingness to communicate cross-culturally in the future.

An Ecological Model for Scaling and Translation: Maximizing the impact of Research and Development Interventions

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Abstract: Scaling and translation constitutes essential challenges for educational fields. Gold standards are not possible in education because student-centered processes assume variability in different situations rather than adopting a ‘one-size fits all’ form of instruction. This paper proposes a more nuanced ecological model to describe the scaling efforts of educational innovation within the Singapore context. In this model, innovations “flourish” under different conditions with various structural supports depending on their complexity. The spreading of educational innovations from a centralized agency would be limited. Instead, teacher/researcher-led and school-led innovations would be encouraged and supported throughout the system. By going through multiple local instantiations of innovations, efficiency and cost effectively issues are addressed and teacher agency is nurtured through professional learning communities and communities of practice. System-wide baseline data is encouraged to keep tab of the growth and spread of innovations, identify gaps, and recognize areas where nudging and further supports are needed.

Keywords: Scaling and Translation, Golden Standard, Sufficing Standard

1. Introduction

The education research funding in Singapore spans two time periods (2002-2007, 2008-2012) accumulating to an approximate amount of 150 million Singapore dollars. In the first period (2002-2007), the budget from the Ministry of Education, Singapore (MOE) focused on establishing research centers at the National Institute of Education (NIE). Another goal was to change and enact new pedagogies; focusing on culturing student-centered pedagogies and participations in classrooms and beyond. In the second period, funding continued to sustain the kinds of education research populated across the Singapore education system. Research had begun to play an inevitable role in the change-reform process. These research efforts brought about various successful educational innovations, such as Group Scribbles (Chen and Looi 2011), Seamless Learning (Wong and Looi 2011), Productive Failure (Kapur 2010), in schools. These examples and many others, both from MOE and NIE, have laid the foundation for a rich and diverse culture of innovation in the schools and across the Singapore education system. Furthermore, it has also enabled the recognition of Singapore’s educational innovations amongst international research communities, practitioners, and policy makers.

With a relatively large investment on research in the last decade, the development of educational innovations in the Singapore context has reached a stage where some fundamental and pragmatic questions are raised:
- How do we “repeat” or “replicate” successful implementations of educational innovations, albeit not necessarily in identical ways, but in more economical and efficient ways?
- How can some “top down” support be provided for bottom up (researchers and teachers initiated) innovations to enable more efficiencies and cost effectiveness, and hence spread the benefits of research to other schools?

This paper proposes to address the above two questions by first arguing that the idea of “replication” is problematic to educational translation and scaling. Second, the paper proposes a way forward focused on the provision of a more nuanced ecological model, which we argue applies to
education, to describe the scaling efforts in the Singapore education landscape as exemplified by various types of existing research projects from NIE.

2. Scaling and Translation Research: From Medical to Educational Fields

2.1 Linear Modes of Scaling and Translation

In the natural sciences, including that of the medical field (see Figure 1), scaling and translation from research to everyday practices is a linear and staged process (Woolf 2009). Stage 1 of the translation research (T1) focuses on testing in laboratory settings with the aim of developing new methods for diagnosis, therapy and prevention (Woolf 2009). In T1 research, clinical scientists are working in laboratories with supportive infrastructures within the institution. This research occurs in community and ambulatory settings. The Institute of Medicine’s Clinical Research Roundtable states that stage 2 of translation research (T2) is about translating results from clinical studies into clinical practice and decision-making (Sung et al. 2003). In T2, research moves out of the laboratory into real world settings. This is the first attempt to bring T1 research to public settings. T2 research yields knowledge about efficacy of intervention in various controlled real world settings. It focuses on how infrastructure, resource constraints, human behavior, and organizational issues affect the efficacy of interventions. It recognizes that translating interventions is a socially complex phenomenon. Stage 3 of translation research (T3) is about disseminating the intervention from controlled real world settings to the general population. In T3, researchers explore ways to apply recommendations into everyday practices (Westfall, Mold, and Fagnan 2007). The focus here is on how interventions work in real world settings. Medical research, as described from the stages, moved linearly from the laboratory to the mass market. The default model is to look for a ‘gold standard’ of an innovation and bring this through the T1, T2, and T3 processes. This dominant thinking is also found in programs such as the i3 (Innovation through Institutional Integration) model of the National Science Foundation (NSF) (The National Science Foundation 2006). See Figure 1.

Figure 1. Linear translation model in medical research (University of Miami, 2013).

Linear models that assume replicating a gold standard are challenged for their appropriateness in education. Different educational studies discuss what “scaling” means and what it entails (see for instance, Klinger et.al, 2013; Fullan 2000; Coburn 2003; Hargreaves and Fink 2000; Bocconi, Kampylis and Punie 2013). On the surface, scaling as defined in education seems to bear some resemblance to the medical sciences -- scaling is about diffusing an innovation from one context to the masses (Klinger et al. 2013; Sternberg et al. 2006).
2.2 Variability Due to Student-centeredness

Scaling and spreading innovations in education is different from the medical field. In education, the focus is on cultivating student-centered process-in-learning such as inquiry and knowledge building. Student-centered processes thus assume variability in different situations rather than to adopt a ‘one-size fits all’ form of instruction. Based on this assumption, we posit that attempts to scale, if consistent to student-centeredness, should not be mere replication from the original intervention, but variations should be allowed to occur based on differences in student profiles, curriculum, teacher dispositions, and others. To maintain the integrity and identity of the innovation, however, there should be core design principles or core fundamentals that should be upheld.

2.3 Educational Settings are Socially Messy and Tacit Knowledge is Needed

In medicine, research starts in laboratories in a context vastly different from the real world when a successful product will be consumed. Transfer of innovations to everyday practices is fixed on a set of procedures. In educational science, the social context is more complicated (Clarke and Dede 2009), and hence socially messy. The education environment is varied and learning is a socio-cultural process (Beach 1999). This necessitates tacit knowledge due to the dynamic interactions between teachers, students, and the situated context where the learning and instruction arises. This is in essence the student-centeredness which MOE is advocating.

2.4 Educational Models of Scaling are Lacking from a Systemic Perspective

Current literature discusses on issues about scaling educational innovation and possible ways to address them (Elmore 1996; Bodily et al. 2004; Clarke and Dede 2009; Klinger et al. 2013). These discussions mostly take the respective innovation or project as the focus. Although they provide detailed accounts about scaling individual local level innovations, this level of analysis lacks the bird-eye or systems’ view of scaling. Understanding scaling at the systems’ level is essential to inform policymakers of different scaling patterns, help policymakers understand teachers’ and students’ needs on the ground, and allocate resources more efficiently.

Policy makers, practitioners, researchers, and other educational related agencies are, however, largely uninformed about how effective innovations can be made more widespread. A literature scan has not found profound theories or sound models for scaling up research that can accumulate into generalizable findings. The process of large-scale adoption of innovations is concerned not simply about “rubber-stamping” the same program into multiple contexts, but on empowering teachers in the design process of student centered lessons, fitting and adaptation for local circumstances (Barab and Luehmann 2003), and others. There is not just one model for successful implementation - there are probably as many models as there are the unique contexts (Leusner, Ellsworth and Goe 2008).

Much greater complexity is involved when educational professionals seek to understand and improve the enactment of innovations, and take it to scale. A systemic approach is needed to spread innovations to improve student learning in design-based research by taking into account the interconnected relations between curriculum standards, curriculum materials, learning activities, formative and summative assessments, professional development practices and educational leadership (Looi, So, Toh and Chen 2011; Pea and Collins 2008), as well as taking into account the aspects of organizational learning (Spillane, Gomez and Mesler 2009).

Considerations of “scale” are a key challenge for school reform. Definitions have traditionally been focused on an innovation-oriented perspective that emphasizes the expanding number of schools reached by a reform or innovation. There are, however, complex challenges of reaching out broadly while simultaneously cultivating the depth of change necessary to support and sustain consequential change. Coburn (2003) and Dede (2006) develop a conception of scale that has four interrelated dimensions: depth, sustainability, spread, and shift in reform ownership to the teacher and the school. To elaborate:

- Depth looks at the nature of change, whether change is affected by the organization’s beliefs, whether individuals’ beliefs and thereafter practices have evolved; whether these changes are merely superficial. It is also important to consider the owner responsible for the change.
• Sustainability is about endurance; how long will the change endure; what strategies are in place to assure sustainability of the change
• Spread refers to the norms, principles, beliefs understood by greater numbers of people. It asks “How widespread is the change?”, “Who is involved in the change?”, “Who should be involved?” and “Who will benefit from the change?”
• Ownership is the attempt to shift reform ownership in terms of knowledge and authority to implementers; the schools who should ultimately “own” the process.

We see this conception of scale as focusing on the spread and reach from an innovation-oriented, local-project instantiation point of view rather than understanding reform, spread and (out)reach of an innovation from a system-wide perspective which is inherently more complex and non-linear. The above criteria is however important when considering local level interventions at respective schools.

3. Proposing an Ecological Model for Scaling and Translation

3.1 Overview

In the education context of Singapore, unlike the medical model, the path towards a greater adoption of educational innovation is complex and cannot be assumed to be linear. Instead we envision a model where various types of innovations (see Figure 2 below) happen concurrently. These innovations “flourish” under different conditions with various structural supports. There is a need to acknowledge that innovations have varying levels of complexities. Innovations that can more easily spread and scale would be those that have an established and socially accepted core kernel design. When such innovations are implemented in different situations, the resources well disseminated, and a sociality of teachers built around it (such as through professional learning communities and communities of practice), we can expect more of such innovations to be taken up by teachers for implementation in their classrooms. There are currently a considerable number of teacher-led projects populated throughout the Singapore education system. Some of these projects have been more successful in spreading across different classrooms and moving towards a school-oriented innovation while others have been less successful. This could be due to the complexity of the innovation and the readiness of teachers. Examples of these teacher-led projects can be found in MOE-NIE initiatives such as eduLab. eduLab is designed to surface and push ground-up Information and Communication Technology (ICT)-enriched pedagogical innovations across schools (eduLab 2009).

![Figure 2. An Ecological Model for Scaling and Translation.](image-url)

MOE and NIE stand ready to engage teachers to spread these teacher-led innovations. We envisage that innovations that are less complex would require less support. To a certain extent, if the sociality built around the innovation is strong, the innovation could continue to grow. Of course, if school-based supports are given, the spreading could happen more quickly at the school-wide and across-school levels. We refer to these as school-led or school-supported projects (see Figure 2). MOE and NIE also recognize that more complex innovations could require higher levels of support to enable it to spread. Such innovations would require the commitment of schools and principals to rally school-based support from more teachers and to make resources available in order to better support
such innovations to grow. Likewise, school principals who opt to undertake these more challenging innovations will be supported and partnered with NIE researchers (in specific instances). Given the more complex nature of these projects, a richer partnership is envisaged.

Another kind of innovation could be for projects that grew from teacher-levels or school-levels to system-wide levels. Or when MOE initiates certain system-wide projects or initiatives due to the need to regulate local level initiatives or when certain reforms are needed due to a systems’ view to narrow gaps in achievement. We thus propose that instead of viewing T1, T2, and T3 as stages to be enacted linearly, we reframe:

- T1 as Teacher-led;
- T2 as School-led; and
- T3 as System-led.

Teachers and researchers can also take a theoretical basis (T0) and work around it in classroom (or equivalent) settings and these become T1 projects. All three types of innovations happen concurrently for a healthy ecology to occur. Growth and spread of innovations happen locally and the state of play can be understood according to Coburn’s (2003) and Dede’s (2006) frameworks and criteria.

3.2 Organic and Evolutionary Growth

With the three types of innovations (Teacher-, School-, and System-led innovations) populated across the system, we envisage that as teachers and schools adopt, adapt and implement innovations (with MOE’s continued support and other school-based structures), local cultures of innovation would be nurtured. Due to the complexity of innovations and the nature of support required, it would be reasonable to assume that our education landscape would be one which is populated with more teacher-led (T1) and school-led (T2) innovations instead of system-led initiatives, especially in the milieu of student-centered pedagogies. The more radical and complex the innovation compared to conventional practices, the greater the need for local instantiation and spread in order to develop and cultivate the tacit knowledge underpinnings of the innovation.

As change, growth, and eventual impact of innovations to the community would be gradual, an evolutionary rather than a radical change process should be expected. With this organic approach, teachers and schools can begin the scaling-adoptions process at different starting points. Teacher-led or teacher-supported innovations relate to experimentations at the local (classroom) level in small instantiations. The focus of these innovations relates to the identification and contextualization of innovations to meet students’ needs and address issues in classrooms, especially of student-centered pedagogies and designs. Teachers work collectively towards refining innovations, identifying the core or kernel principles, and building teaching resources that allow innovations to be implemented in classrooms. Through experimentations and consistent dialoging, teachers may begin to adapt innovations for use with their own students in different classroom contexts. Teacher-led (T1) innovations and experimentation could grow to influence more people in various local instantiations. In other words, teacher-led (T1) innovations could be scaled locally to include more subjects, classes, different student profiles, and result in eventual “promotion” to school-led (T2) status. When spreading from teacher-led to school-supported status, implementation efforts are locally driven and emerged.

These innovations could subsequently be taken up by MOE and these could be provided with financial and infrastructural supports to ensure innovations’ spread and sustain with greater efficiencies. As such, these efforts could eventually be system-led innovations (T3). Examples of these T3 innovations could include the leveling up of the base of core literacies in order to bridge achievement gaps or when local growth models may be too slow for certain policy priorities.

3.3 A Sufficing Standard (instead of Gold standard)

It is important to recognize that when innovations spread in these ways, we do not seek to ask if a gold standard has been achieved before allowing for the spread to occur. Instead, we seek to ask if the teachers are enthused, committed, and ready about the innovations, whether teachers are able to take innovations to their own respective classrooms (or equivalent) and implement the core or kernel ideas of that intervention. Moreover, are resources to support these subsequent take-ups available at the school, cluster, or MOE levels to support the spreading of innovations? Are school leaders willing to
support these teachers to experiment and permit possible implementation gaps to happen, if any? And are teachers able to collect evidence-based data for their experimentations to exemplify some form of rigor? We connote that the above questions are important to the issues around a sufficing standard for spreading of innovations, rather than a gold standard. Some possible indicators of spread could be the adoption of school-led innovations by other schools, an increasing community of teachers involved around an innovation, more dialogue and sharing between schools, and others.

As we further study into the various teacher- and school-led/supported innovations, we will elaborate on the sufficing standards to inform the scaling efforts at the policy and research considerations of MOE and NIE respectively.

To reiterate, the use of “sufficing” standard as opposed to “gold” standard is adopted and argued for in this paper to shift the focus away from expecting and deriving a par excellence model which can be considered ripe and optimal as a gold standard to be rolled out to the system at large.

4. **System’s Level Data of the Growth and Spread of Student-Centered Innovations**

In typical scaling efforts connoted by the sciences, policy makers would roll out to the whole system or nation a certain proven drug or product. In this kind of linear scaling, data would be collected on its implementation efficacies and degrees of fidelity in terms of benefits to the different user groups. Figure 3 shows the many combinations of contexts which have to be developed centrally in order to roll out an education program. LA, MA, HA in this figure represents low achieving, medium ability, and high ability students respectively. For example, the identified smaller cube in the larger cube below seeks to know how to scale curriculum in classrooms with low achieving (LA) students.

![Figure 3. Contexts to consider in scaling education programs.](image)

The concerns of policy makers are valid nevertheless. However, the strategy we are advocating in this paper is for the contextualization of pedagogy and designs to be developed and capacity of teachers to be built to enact student-centered inquiry and facilitation to be cultivated locally. Since teaching requires the interplay of tacit knowledge and developed resources, enabling teachers to have the space and time to work collaboratively with fellow teachers on crafting the lessons would be a great way forward towards fostering teacher agency and professionalism.

Nevertheless, if we were to argue for this bottom up approach of scaling with top down support (for example, from MOE), policy makers would still want to know a systems’ view of what is happening with respect to the various (reframed) T1, T2, and T3 innovations grown locally and supported at the various levels of the system. MOE would also want to know, for example, the number of schools across the system which has these innovations, the kinds of innovations and on which subject domains, the grade levels in which they have been implemented, and the local spreading that have occurred or otherwise, the number of teachers involved, the number of local teacher communities, and other such data. Data for the spread of innovations across school clusters and zones is another example of system-wide data that is useful for policy makers and NIE plays a role in providing such data.
As to data collected from 2009 to 2012, NIE’s intervention research projects have spread across Singapore in primary school, secondary schools and junior college (as shown in Figure 4 and 5). To provide a more concrete example, NIE’s research landscape has constituted an array of T1 (teacher/researcher-led) and T2 (school-led) projects (see Figure 6 below). NIE does not have system-led projects as yet. Categorizing each innovation into one of the T0/T1, T1/T2, and T2/T3 stages and allowing for natural “growth” may be sufficient to create a diverse and rich culture of innovation in our schools.

- **T0/T1** means that the researchers have worked with teachers to bring basic research ideas into the classroom, for example, Knowledge Building (Ng, Looi and Chen 2008) and Productive Failure (Kapur 2010).
- **T1/T2** means that the classroom intervention has moved to the school level.
- **T2/T3** means that the school’s innovation has spread to other schools (but not to the whole system).

We envisage that the data for scaling or knowing what is happening as far as scaling interventions’ attempts are concerned can be integrated with the systems’ wide baseline research.
conducted by NIE and MOE in the future. When we are able to understand local phenomena and spread, we can further optimize the efficiencies and cost effectiveness such that subsequent instantiations can be done more economically, without compromising the core and kernel sufficing standards.

5. Discussions and Conclusion

Educational settings differ across classrooms and contexts. In the milieu of student-centered pedagogies and designs, the celebration of diversity in student learning and participations are desired. Hence, there is no one-size-fits-all solution for scaling. Instead, we should have a top down support for bottom up initiatives where flexibilities and adaptivities occur throughout the system with sufficing standards as largely determined by teacher readiness, leadership supports, and infrastructural adequacies at each local instantiation. While celebration of diversity is at local levels, the system keeps tab of this growth and spread of innovations with system wide baseline data in order to identify gaps, concerns where nudging is necessary for some localities, and to identify if future work and initiatives are needed.

Taking basic research to the classroom is anything less than straightforward. It involves both researchers and teachers painstakingly implementing these ideas with evidence to support their work trajectories, trailing blazing in “messy” classroom situations, till the innovation succeeds. School based professional learning communities (PLCs) and cluster-based communities of practices (CoPs) can be leveraged to monitor and mentor teachers on their teacher- and school- led pathways. Researchers and their innovation/intervention projects should also be integrated into teachers’ existing PLCs and CoPs. Through these partnerships, more concerted efforts can be made to advance 21st century pedagogies and literacies throughout the system.

Policy makers should also be careful not to overly expect system roll-outs to be particularly high in fidelity and to be also concerned if perception survey results show that these schemes and initiatives are working very well. The tacit nature of educational settings requires time for interventions to take root, and for teachers to experiment and to change pedagogies. We need to also acknowledge that teachers believe in what they do, and for very good reasons, and hence change and reform take time. The system should also know the ‘good work’ that is happening at each local level before assuming that change is always for the better. Hence, the need for local and systems’ level data is imperative, going forward. Unpacking the sufficing standards at each local instantiation and supporting the spread of educational innovations would be a productive means to enable the system to optimize.

With the above instantiations, and with sufficient time, a natural and healthy state and culture of innovations across schools in Singapore will surely develop in a gradual and evolutionary manner. Policy makers, researchers, and schools will undertake research and development efforts to further understand and implement the scaling process with a view to leveling up the base of 21st century learning and literacies, for all stakeholders, across the Singapore education system.

References


An Educational Practice Using a Code Reading Support Environment for Understanding Nested Loop

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Abstract: In this paper, we describe a code reading support environment and a classroom practice using our system for understanding of nested loop. In our preceding work, we had practiced an exercise class in nested loop with a code reading support environment. The evaluation results suggested that students could obtain an expected learning effect roughly by using our system. However, we also found some of them had reached a learning impasse in the classroom. We tried to cope with them, based on two supporting approaches; to bridge a gap between generalization structures of program code and corresponding operations, and to make students capable of predicting the behavior of the nested loop. We extended the preceding system with some new functions according to our approaches, and practiced renewed exercise class in nested loop with our system. The evaluation results suggest that our new system has a certain correlation with understanding of nested loop.

Keywords: Education for programming, Domain world models, Learning environment for exercise, Education for informatics, Classroom practice.

1. Introduction

As an information level in our society advances, increasingly more various students need a computer programming education (Robins, Rountree, & Rountree, 2003; Pears et al., 2007). In our classroom experience, we have been attracted an attention by following three fundamental skills which novice programming students tend to feel difficult to acquire:

F1. Nested structure; some students are hard to understand it in control flow or code description.
F2. Generalization; some students are hard to generalize a set of concrete operations into an abstract function with some variables.
F3. Tracing; some students are hard to grasp values of variables clearly, which is changing through each statement.

Nested loop is a learning target which novice students would stumble for the first time, because learning of that needs to understand or to acquire above all three fundamentals. Koppelman and van Dijk (2010) emphasized the importance of nested loop as one of the targets to understand the concept of abstraction. However, limited time of the course would hardly allow students to get a deep understanding of these fundamental concepts. In order to have our students learn them efficiently, we have tried to introduce learning support systems into our classroom exercise in nested loop (Kogure et al., 2013).

Generally, programming students learn algorithms, code-readings and codings in turn. We have already developed the learning support system for the code-reading stage (Kogure, Okamoto, Noguchi, Konishi, & Itoh, 2012). As in our preceding work, we assumed that learners understand programs and algorithms by having an image consisting of three fields in their minds: program-code, objects processing by the program (target domain world), and sequence of concrete operations for the target domain. Learners have to grasp the relationships and correspondences among the components in each
field there. Our preceding system supports to understand a program-code by visualizing three fields and their relationships.

In our preceding work, we practiced exercise classes in nested loop with our system and found some students had reached a learning impasse in the classroom. Based on implicit and explicit feedback from our students, we constructed two approaches to cope with the problems; to bridge a gap between generalization structures of program code and corresponding operations, and to make students capable of predicting the behavior of the nested loop by observing two characteristics in the code.

In this paper, we describe new functions incorporated to our system according to these approaches and renewed classroom practice for nested loop. The evaluation results suggest that our extended system has a certain correlation with understanding of nested loops. We describe the preceding system in Section 2, two approaches to avoid the impasse in Section 3, an overview of our extended system in Section 4, respectively. We provide an overview of our classroom practice, our controlled experiment, and evaluation result of our system in Section 5, and we conclude with a brief summary and discussion of future work in Section 6.

2. Learning Environment for Programs and Algorithms

2.1 Our Preceding Work

In our preceding work, we assumed that learners need to have an image consisting of three fields and to grasp the relationships among their components; program-code field (PF), target domain field (TDF), and operations field (OF). Under this assumption, we developed the system which supports students to understand programs. Figure 1 shows the overview of learning support environment provided by the system (hereafter called LEPA). Each of three fields is reproduced in (A), (B) and (C), respectively.

Figure 1. Overview of the environment provided by LEPA

A Learner can click one of operations in (C), so that the system displays the state of target domain after executing it in (B). S/he can know the role of a certain sequence of operations by comparing or observing visualized TDF before and after executing that. The system highlights the code fragment in (A) corresponding to the selected operation in (C), and vice versa because the system also allows him/her to click a fragment in (A). S/he can know the correspondence between a code fragment and an operation. We believe that s/he can store many pieces of intelligent information from
visualization by LEPA: what may happen in TDF by executing a concrete operation, or what kind of the code is needed to cause an effect on there.

Learning with LEPA is based on learner's externalization of his/her stored information. The externalization can be done by his/her packing and tagging process using GUI interface. If s/he found a certain sequence of operations having single abstract function in (C), then s/he could use GUI interface of the system in following two steps:

1. S/he can push “pack” button to pack the selected operations sequence into a package. Nested structure of packages is allowed.
2. S/he can tag the package with a natural language description according to its function (as in pointed part in Figure 1).

The resultant packing structure of operations sequence gets closer to the program code structure, ideally. We consider s/he will get to understand whole control sequences of the program code in the overall process of a series of these activities.

An activity of externalization can be classified into two classes according to the repetitiveness in target operations: abstraction for operations without that, generalization for ones with that. LEPA supports the former activity by the function of packing operations, and the latter by the one of tagging n-th lap of a loop (as in Figure 2).

![Figure 2. Tagging a package and tagging n-th lap of a package](image)

2.2 Related Works

Shneiderman, Mayer and Heller (1977) defined a flowchart to be represented a high level definition of the solution to be implemented on a machine. Based on that, they stated flowcharting and programming can be separable independent tasks. It suggests that we may treat elaborating an algorithm and writing a program code as two separated tasks. We think that understanding an algorithm and a program code also can be separable.

So far, several intelligent tutoring systems are developed to support programming learners. They include RoboProf (Daly & Horgan, 2004), JITS (Sykes & Franek, 2003), J-LATTE (Holland, Mitrovic, & Martin, 2009), BITS (Butz, Hua, & Maguire, 2006), and so on. Several learning support systems based on algorithm visualization are also paid a lot of attention, including TRAKLA2 (Malmi et al., 2004), Jeliot3 (Moreno, Myller, Sutinen, & Ben-Ari, 2004; Čisar, Pinter, Radosav, & Čisar, 2011), ViLLE (Rajala, Laasko, Kaila, & Salakoski, 2008), and so on. Classifying these systems from the standpoint of the tasks understanding an algorithm and a program-code, the main target in every system seems to support either of them. Our attractive target is a gap between two tasks. We consider that these systems will provide insufficient support to bridge the gap.

Learners who have a proper understanding of an algorithm can reproduce its behavior for a concrete data. A sequence of operations in LEPA is a sequence of natural language descriptions representing the algorithm behavior. Hence, operations sequence can be regarded as an externalization of his/her understanding of the algorithm. Some other existing systems visualize relationships between a program code and its target domain world. LEPA also does it, and furthermore, relationships between a sequence of operations and its target domain. It also visualizes the correspondence relationships between a code fragment and an operation. We expect that these visualizations of three fields and
relationships among them contribute to bridging the gap between two tasks. That is why we base our approaches to bridge the gap on LEPA.

Given a program comprehension task to a programmer, his/her procedure for code reading consists of two steps normally; recognizing the function of groups of statements, and then piecing together these chunks to form ever larger chunks (Shneiderman & Mayer, 1979). S/he continues these steps hierarchically until the entire program is comprehended. LEPA has a function to support a learner to behave oneself like that in OF. Therefore, users can learn the procedure for code reading. However, if the chunk corresponds to iteration like a loop, it is often the case that his/her recognition involves generalization with some variables. As described below, LEPA supports insufficiently to generalize an iterative package.

We can find some systems targeting nested loop, including AlgoTutor (Yoo, Yoo, Seo, Dong, & Petty, 2012), the tutor developed by Dancik and Kumar (2003), and so on. However, it is not evident how they lead learners to understand or to acquire the fundamental concepts F1, F2, and F3 described in Section 1. Our works described in this paper aim to sophisticate the learning supports in LEPA by elaborating the strategy of hierarchical procedure for code reading.

3. Our Supporting Approaches

In our preceding work, we had practiced an exercise class in nested loops with LEPA. In that class, we found some of the students had reached a learning impasse. Based on the score differences between pre/post tests, the system did not have statistically significant correlation with student's ability of generalization. In this section, we describe two approaches to tackle them.

3.1 A Gap between the Representations of Generalization

Packing the operations is taking them closer structurally to the program code. However, we can find a gap between the structure of a package and corresponding fragment of program code as in Figure 3.

![Abstraction and Generalization](image)

**Figure 3.** A gap between generalized operations and program code

The right side of Figure 3 shows a program code which displays a N-step pyramid by outputting an adequate number of spaces, asterisks, and new-lines. Other side shows a transition of the package structure corresponding to the code. This would be the most possible transition, we think.
We expect those packages are made through following steps of a student’s learning: First, s/he observes three fields, and consequently makes two packages like “output x spaces” and “output y asterisks”. Here, s/he assigns concrete numerics in x and y, not variables. Then, s/he packs hierarchically them plus an operation which outputs a new-line, and tags it “output z-th step of pyramid”. z is a concrete numeric, again. S/he continues these steps until all operations in OF are included in packages. Finally s/he gets N packages, packs them, and tags n-th lap.

In LEPA, the target of a generalization tagging is the first hierarchical level only. It means that s/he tags n-th lap with a variables only on the packages “output z-th step of pyramid”. The system hides deeper levels than it in OF (outputting spaces, asterisks and new-lines). However, a program code of nested loop is given all over the hierarchy. Generalized the first level hierarchy into “output k-th step of pyramid” with variable k, then s/he should also do deeper levels as “output N-k spaces” or “output 2k-1 asterisks”. With the generalizations throughout the hierarchy, s/he should realize the meanings of control statements for nested loops in the program code.

Based on these discussions, we have implemented a function to enable users to generalize a package as keeping the hierarchy explicit, so that s/he can tag n-th lap of inner loops. In addition, we have also implemented one to generate a template of general tag automatically in following steps; 1. discriminating variable words from invariable ones in the set of tags on packages to be generalized, 2. and replacing variable ones to a series of some symbol like “_”.

For example, in displaying pyramid, our system generates templates like “output XXX spaces”, “output ??? asterisks” and “output ___th step of pyramid” from the set of tags. Proposing templates to the learner, our system encourages him/her to formulate “XXX”, “???” “___” with loop control variables in the program code. The screenshot in Figure 4 shows the implemented functions. They are expected to lead learners to understand the structure of nested loops.

![Figure 4](image)

Figure 4. Generalization of packages as keeping the hierarchy explicit

### 3.2 Two Characteristics in Nested Loop Code

Investigating textbooks and exercises, we have classified the behaviors of nested loops learned by students into 4 types. The classification is based on following two characteristics in nested loop code: Ch1. A statement to iterate in inner loop has a reference to control variables of the outer loop. Ch2. A conditional statement of inner loop has a reference to control variables of the outer loop. The complication of behavior of nested loop tends to grow with them, in the order of neither of them, Ch1, Ch2, and both of them. Learning these relationships between the behavior and the characteristics could enable learners to get a deep understanding of nested loop.
A programmer implements loops including not only the identical operations, but also wide variety of repetitive operations by referencing the loop control variables appropriately. For example, different values are displayed by iterative executions of the statement to display the value of variable \( i \) in a loop controlled by \( i \). Therefore, the iteration package corresponding to the statement consists of a sequence of operations with different descriptions each other. The generalization with our system has two phases; to find operations varying regularly in an iterative package in OF, and to formulate the regularity.

A nested loop increases the diversity of repetitiveness in the corresponding operations. We have to take account of not only inner and outer loops in which their control variables are referenced respectively, but also loops with above two characteristics. A nested loop with Ch1 has operations with varying representation in each iteration step of the outer loop, that is, each inner loop. For example, left side of Figure 5 shows a program code outputting different values according to each iteration step of the outer loop. On the other hand, a nested loop with Ch2 has the different number of operations corresponding to the inner loop according to every iteration step of the outer one. For example, right side of Figure 5 shows a program code where the different number of operations corresponds to the inner loop according to every iteration step of the outer one.

![Figure 5](https://via.placeholder.com/150)

**Figure 5. A program-code with Ch1/Ch2 and its operations sequence**

We call the nested loops with Ch1 to “step contents varying type” of nested loops, and those with Ch2 to “step times varying type”. A learner needs to recognize the repetitiveness of the operations sequence appropriately with or without these characteristics, in his/her series of packing. Furthermore, to recognize the repetitiveness, a learner needs to anticipate the regularity in OF according to characteristics in PF.

Based on these discussions, we have planned to teach students these characteristics, aiming to allow them to cultivate a better understanding. We have also implemented another function to support to learn them, which asks for an answer to the question; which type of nested loop does the one given by our system have; step contents varying type, step times varying type, or both types? For the students who cannot answer, our system gives a following sequence of stepwise hints:
1. Hints on which part of the program-code they should focus.
2. Hints about what characteristics they should read from the focusing part.
3. Characteristics that should have been read.

### 4. Our Extended System

#### 4.1 Overview of Our Extended System
We show an overview of the environment provided by our extended system in Figure 6. Our system places more emphasis on supporting to learn nested loops than LEPA. Our system leads learners to learn based on following scenario of nested loop learning.

Figure 6. Overview of the environment provided by our system

Ex1. Tracing the program code to understand the behavior and control flow over the entire program.
Ex2. Packing the sequences of operations to recognize abstract functions and to understand the entire program as a function hierarchically.
Ex3. Generalizing the packages of operations sequences to understand the structures of the nested loop.
Ex4. Observing the characteristics of nested loop on the program-code to cultivate a better understanding of nested loops.

In nested loops, the repetitiveness to find in a generalization phase appears not on the concrete operations but on the tags on packages packed by the learner. We have implemented following functions to bring it to his/her attention in Ex3 above.

- Autocomplete function to support to make the repetitive packages by displaying the learner’s tagging history.
- Function to support to focus on repetitive packages by setting similar tags to the same color.
- Function to support to look up a repetitiveness on the tags by hiding concrete operations.
- Function to support to tag $n$-th lap appropriately by providing the template of generalization tag.

4.2 Expected Learning Effect

Preceding educational practice suggests that learning with the environment visualizing three fields and relationships among them has a rough correlation with understanding or acquiring fundamentals F1 and F3 described in Section 1. In addition to these effects, our system could bridge the gap between each representation of generalization in the program code and a sequence of operations, and could lead learners to better understandings about nested loops. Consequently, it could also lead them to understandings of F2. We have hypothesized following two learning effects of our extended system.

Hypo1. Functions proposed in Section 3.1 could promote learner's understandings of behaviors and structures of nested loop.

Hypo2. Functions proposed in Section 3.2 could promote learner's understandings of relationships between implementations and behaviors of nested loop.
5. Evaluation of Learning Effects Based on Educational Practice

5.1 Overview of Classroom Practice

For the purpose of verification of two hypotheses described above, we practiced two consecutive exercise classes in nested loop with our extended system. Our classes were incorporated into a series of actual classes being held in department of administration and informatics, Hamamatsu University. The department holds two courses “Programming I” and “Programming II” for second year students. Our classes were practiced in the latter. The number of attending student was 12. Each of the students is majoring in business administration and had less than a year of learning programming.

In the first class, a teacher who regularly teaches the course gave a lecture on single and nested loops in 60 minutes as refresher training. The lecture includes the characteristics of nested loop described in Section 3.2. At the end of the class, we conducted a 15 minutes pretest to judge the students’ understanding level of nested loops before using our system. In the second class, we allowed the students to use our system to learn nested loop. The program for this exercise is the one that displays a 5-step pyramid with spaces, asterisks, and new-lines. Before the exercise in the class, the teacher described the aims of the exercise and the environment provided by our extended system. During the exercise, neither the teacher nor we provided help to the students in understanding the program. After the 60 minutes exercise, we conducted a 15 minutes posttest to judge the students' understanding level of nested loop after using our system. We used BB FlashBack Express 3 (available on: http://www.bbsoftware.co.uk/BBFlashBackExpress.aspx) for recording the screen videos of students' interactions with the environment.

The programs used in the pretest and the posttest are different; however, the questions are almost the same. Question 1 (Q1) asks the execution result expected by tracing the entire program including nested loop by hand. Question 2 (Q2) asks the code fragment in the control of the inner-loop with the execution result given, and Question 3 (Q3) asks that of the outer-loop. Question 4 (Q4) asks the characteristics of nested loops to be expected to appear on program-code, given the execution results only. Q1, Q2, and Q3 are designed to verify the Hypo1, and Q4 for the Hypo2.

For the purpose of more detailed verification of advantage of learning with our system, we conducted another controlled experiment with 5 students as the control group. They are the second year students in the same course as the experimental group, but have not attended in our practiced class. First, they were given the same lecture on loop as experimental group in 60 minutes, including the characteristics of nested loop, and then we conducted the 15 minutes pretest. Next, they did the self-study with textbooks and lecture materials, never using our system. Before the self-study, the teacher described the aim of that is to understand nested loop with an example program. The example program is the same as one in the exercise practiced. The teacher also described the direction for self-study should be based on tracing the program. After the 60 minutes self-study, we conducted the 15 minutes posttest. The pre/post test are the same as ones for the experimental group.

Table 1 shows the differences of the average score on each question between pretest and posttest of experimental and control group. We marked each question in both test as following; Q1 out of 3, Q2 out of 9, Q3 out of 3, and Q4 out of 48. A tendency can be seen in that experimental group grows the marks significantly between the pre/post test but the control one does not.

Table 1: The differences of the average score between pre/post-test

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>experimental</td>
<td>0.83</td>
<td>0.75</td>
<td>0.50</td>
<td>1.50</td>
</tr>
<tr>
<td>control</td>
<td>1.20</td>
<td>0.20</td>
<td>-0.60</td>
<td>-5.70</td>
</tr>
</tbody>
</table>

We think that more progress in control group on Q1 is caused by the direction for their self-study provided by the teacher. They could have consumed much of their time in tracing the program. Therefore, we consider they have an advantage over experimental group whose learnings consisted of 4 stepwise exercises.
5.2 Discussion

We examined carefully footage recorded for each student of experimental group in order to analyze learning effects in more detail. Consequently, we found the interactions with the learning environment provided by our system differ significantly among each of the students. For following 4 activities, we categorized the students into those who performed the activity (positive group) and those who did not perform the activity (negative group).

A1. The student consumes enough time in tracing the program (Ex1).
A2. The student packs all the operation sequences corresponding to the inner loops and tags all the packages (Ex2).
A3. The student accepts the guidance function of outer loop generalization appropriately (Ex3).
A4. The student uses the function to support to observe the characteristics of nested loop (Ex4).

We consider these activities lead the learning effect as follows.

- A1 to be the action to understand the behavior of the entire nested loop to acquire tracing skills (F3).
- A2 to be the action to understand the step contents of the inner loops and to understand the structure of the nested loop (F1).
- A3 to be the action to understand the step contents of the outer loop and to acquire the skills to generalize concrete operations (F2).
- A4 to be the action to understand the characteristics of the nested loops and to understand the relationships between the behavior and the characteristics on the program-code.

We expect the students performed these activities to grow their marks; the student performed A1 would grow his/her mark on Q1, the one performed A2 would do that on Q2, likewise the one performed A3 and A4 would do that on Q3 and Q4, respectively.

Table 2 shows the differences of the average score on each question between pretest and posttest of positive and negative group from A1 to A4. By performing an independent t-test, if the difference between negative and positive is statistically significant progress at the level \( p = 0.05 \), we put an asterisk next to the number. Each positive group shows significant progress their marks on corresponding question on the whole as expected.

<table>
<thead>
<tr>
<th></th>
<th>Positive</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
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<td>1.57</td>
<td>1.29&lt;sup&gt;*&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>0.00</td>
<td>-0.50</td>
<td>-0.75</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Positive</td>
<td>0.80</td>
<td>2.60&lt;sup&gt;*&lt;/sup&gt;</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>1.00</td>
<td>-0.67</td>
<td>0.50</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Positive</td>
<td>1.17</td>
<td>1.67</td>
<td>1.50&lt;sup&gt;*&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>0.60</td>
<td>-0.20</td>
<td>-0.60</td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Positive</td>
<td></td>
<td></td>
<td></td>
<td>2.63&lt;sup&gt;*&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td></td>
<td></td>
<td></td>
<td>-0.75</td>
</tr>
</tbody>
</table>

The progresses in Q1, Q2 and Q3 suggest to favor the Hypo1, and that in Q4 suggests to favor the Hypo2. Hence, the results suggest that our system has a certain correlation with the understandings about nested loops on condition that user performs the expected activities.

6. Future Work

In this paper, we described the classroom practice for understanding of nested loop and the learning support system adopted there. Nested loop is an appropriate target to learn the fundamental skills of programming. We think that learning support systems contribute to understand or acquire them efficiently and effectively.

In the preceding educational practice with LEPA, we found some of the students had reached a learning impasse. We tried to cope with them, based on two supporting approaches; to bridge a gap between generalization structures of program code and corresponding operations, and to make students capable of predicting the behavior of the nested loop by observing two characteristics in the code.
According to them, we developed the function to generalize packages as keeping the hierarchy explicit for the former, and the function to support to observe the characteristics of nested loop for the latter.

We evaluated the effect of our system added the functions above in the actual classes. We also conducted a controlled experiment with 5 students as control group to verify the advantage of learning with our system in more detail. The evaluation results based on the scores on pre/post-test suggest that learnings with our system have a certain correlation with the understandings about nested loops.

As described in (Kogure et al., 2013), we have not only intended to support learners to learn nested loop. Our goal is to construct new form of education for programming with our code reading support environment. The correlation observed in the classroom practice suggests that our system will contribute to learner’s understanding or acquisition of three fundamentals; F1, F2, and F3. We plan to collect more knowledge from more practices with our system, and to enhance our system and our classes.

Acknowledgements

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References


Characterizing TPACK Transformations in the Design of School-Based Pedagogical Change

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Abstract: The technological pedagogical content knowledge (TPACK) framework has been accepted as a powerful framework to examine ICT integration in the classroom. However, nearly a decade of TPACK research has not documented clearly how teachers synthesize the different aspects of their existing technological, pedagogical and content knowledge into a new form of knowledge to support ICT-integrated lessons. This study unpacks how teachers and researchers who are collectively engaged in lesson design sessions by putting their existing knowledge together through talk and jointly designing new TPACK to support pedagogical change in a school-based context. The study found that to do so, TPACK transformations need to occur in the areas of pedagogy, content, and technology through iterative problem-solving. The study indicates that such kinds of design efforts are potentially very important to develop deep pedagogical understanding among teachers.

Keywords: Technological pedagogical content knowledge, design thinking, teacher professional development

1. Introduction

Information and communications technology (ICT) has been envisioned as the catalyst of pedagogical change in schools. However, empirical studies of teachers’ computer use in classrooms show that ICT is predominantly being used to support information transmission (Gao, Choy, Wong, & Wu, 2009; Lim & Chai, 2008; Ward & Parr, 2010). Obviously, teachers have yet to change their pedagogical practices towards the constructivist and student-centered uses of ICT that are often associated with pedagogical change. One reason could be that teachers are drawing upon their knowledge of existing instructional repertoires whereas pedagogical change requires them to design new pedagogical practices (Hammerness et al., 2005). Teachers therefore need to develop new forms of technological pedagogical content knowledge (TPACK), or knowledge for ICT integration (Mishra & Koehler, 2006) to support these changes.

It is premised that TPACK is transformative in nature (Angeli & Valanides, 2009) and studies have found that it emerges as teachers engage in lesson design activities (Koehler, Mishra, & Yahya, 2007). During lesson design, teachers draw upon their technological knowledge, pedagogical knowledge, and content knowledge to create concrete lesson ideas that are expressions of their TPACK (Cox & Graham, 2009). Teachers’ lack of design expertise has been identified as a critical barrier against their successful integration of ICT (Tsai & Chai, 2012). However, we suggest that teachers’ design expertise is encapsulated in their ability to use and transform their existing TPACK as epistemic resources during lesson design. Ideas for ICT innovations can only emerge successfully when teachers are able to successfully maneuver these TPACK transformations. At present moment, there are ICT lesson design models (eg. ASSURE, Heinich, Molenda, Russell, & Smaldino, 1999) that depict the ICT lesson design processes. However, how teachers form and develop TPACK throughout lesson design is still not well understood (Cox & Graham, 2009). Though it is acknowledged that TPACK is formed through collaborative design, recent reviews did not surface any studies that unpack how the transformation of TPACK emerges through design talk (see Chai, Koh & Tsai, 2013).

This study therefore aims to characterize the kinds of TPACK transformations that take place during teachers’ attempt to design new pedagogies for their existing lessons. Using content analysis, we studied a team of teachers in a Singapore primary school who were revamping their math curriculum with inquiry-based learning. Audio recordings were made of their regular design discussions across six
months and content analysis using Mishra and Koehler’s (2006) TPACK framework was used to characterize how teachers transformed their TPACK as they made critical design decisions. Implications for the development of teachers’ design capacities are discussed.

2. Literature Review

2.1 The TPACK Framework

The TPACK framework was proposed by Mishra and Koehler (2006) as an extension to Shulman’s (1986) proposition that teachers possess a unique form of know-how termed as pedagogical content knowledge. Shulman emphasized that pedagogical content knowledge went beyond teachers’ pedagogical knowledge and content knowledge. It encapsulates how teachers draw upon their knowledge of classrooms, students, and curriculum to formulate instructional activities for specific groups of students. To consider teachers’ knowledge of ICT integration, Mishra and Koehler proposed that seven forms of teacher knowledge can be derived from the interconnections among technological knowledge, pedagogical knowledge, and content knowledge. These are:

1. **Content Knowledge (CK)** – knowledge of subject matter.
2. **Technology knowledge (TK)** – knowledge of various ICT tools.
3. **Pedagogical knowledge** – knowledge of the processes or methods of teaching.
4. **Technological content knowledge (TCK)** – knowledge of subject matter representation with technology.
5. **Technological pedagogical knowledge (TPK)** – knowledge of using technology to implement different teaching methods.
6. **Pedagogical content knowledge (PCK)** – knowledge of teaching methods for different types of subject matter.
7. **TPACK** – knowledge of using technology to implement teaching methods for different types of subject matter.

TPACK describes ICT pedagogies employed for specific lesson topics whereas TCK and TPK describe the general technologies that can be used to support different content or pedagogical areas respectively (Cox & Graham, 2009).

2.2 TPACK Transformations Through Design

Niess’ (2013) study of in-service teachers’ TPACK across three years suggest that they needed to first recognize an ICT tool’s relevance before they were able to make the pedagogical changes to adapt, explore, and advance these tools within their school curriculums. Teachers’ conception of lesson strategies, and therefore their TPACK enactment, are also influenced by school policies, day-to-day logistical concerns as well as the kinds of ICT resources available in their schools (Koh, Chai, & Tay, 2014; Porras-Hernández & Salinas-Amescua, 2013). Such kinds of decision-making may not be adequately captured in existing ICT lesson design models. An example is ASSURE which characterizes design as having defined stages including learner analysis, statement of standards and objectives, selection of pedagogies and media, implementation, evaluation and revision (Heinich, et al., 1999). This model may not depict the reality of teachers’ lesson design practices as recent studies found these processes to be iterative and emergent rather than procedural (Laurillard, 2012; Summerville & Reid-Griffin, 2008). In fact, the latter descriptions of teachers’ ICT lesson design practices are closer to the processes used by designers in fields such as product design and architecture. It was found that these designers engaged in iterative rounds of “reflection-in-action” where they would tinker with ideas in order to better understand their design problems (Cross, 2001; Schön, 1983). To these designers, design is essentially a process whereby their knowledge about design problems are continually being created, refined and therefore transformed through the exploration of ideas (Lawson, 1997).

For teachers, there is evidence that they create TPACK as they design ICT lessons with respect to particular instructional problems. Analysis of graduate students and pre-service teachers’ reflections
of their engagement in lesson design projects assigned during teacher education courses found that their consideration of single knowledge sources such as TK and PK were more predominant at the early stages of lesson design whereas their considerations of integrated knowledge sources such as TPK and TPACK were more predominant at the later stages of lesson design (Koehler, et al., 2007; Koh & Divaharan, 2011, 2013). The presence of the integrated sources of TPACK in teachers’ reflections is a particularly important finding because this indicates teachers’ ability to connect their different knowledge bases in order to create particular pedagogical uses of ICT. Mishra and Koehler (2006) remarked that these integrated sources of TPACK depict teachers’ ICT integration capacities. While the studies of graduate students and pre-service teachers cited earlier do provide some insight about teachers’ TPACK development, there is little detail about the design processes that enable teachers to develop the integrated forms of TPACK. Furthermore, these studies are based on design projects carried out in teacher education courses and may not be reflective of how lesson design occurs in school-based contexts. It is important to understand how teachers develop TPACK to support pedagogical change but there is a dearth of studies in this area at present moment. Correspondingly, the applicability of the TPACK framework for guiding teachers’ lesson design has often been questioned (Cox & Graham, 2009).

2.3 Research Question

Considering the gaps in extant TPACK research, the following will be the research question of this study:

What kinds of TPACK transformations are needed to support a pedagogical change?

3. Methodology

3.1 Study Context

The study was carried out with a team of six teachers from a Singapore primary school. As a participant of the FutureSchools@Singapore programme, the school has a mandate to develop ICT-enabled pedagogical innovations. The team comprised of the Head of Department (HOD) of Mathematics and five other teachers who had between 5-10 years of teaching experience. Researchers from a teacher education institution and a math specialist supported the teachers in this change and participated in these discussions. In a prior analysis of their students’ performance in the different math exam questions, the team felt that their students’ communication of mathematical reasoning could be strengthened. As this is an important component in national examinations that students take at primary 6, the teachers wanted to help students build this important skill from primary 3. From their experiences in teaching Science, the teachers felt that an inquiry-based approach could be used because it engages students to explore and explain phenomenon. The teachers therefore chose to adapt the 5E inquiry-based approach used in their Science lessons for this purpose. In this approach, learning occurred through five phases of inquiry - Engagement, Exploration, Explanation, Elaboration and Evaluation (Bybee et al., 2006). This approach was finally integrated into the topics of number patterns, fractions, money and area and perimeter, which were topics that students had more difficulty with.

3.2 The Pedagogical Change

Prior to the integration of the 5E approach, teacher-centered pedagogies were largely used to deliver the various math topics. The design of the inquiry-based lessons was progressively developed and refined as the teachers implemented the lessons for each of the various topics throughout the school year. Generally, the 5E approach was implemented by first Engaging students with a video-based scenario of a real-world problem associated with the math concept they were going to learn. For example, to bring out the issues related to units of measurement in the topic of area and perimeter, teachers showed a scenario of two students who derived different answers for the area of the same table when it was measured using different square units. Using this as a stimulus, students constructed what they know and questions about what they wanted to know about the topic of area (i.e. the K and W portions) of their K-W-L chart. From their responses to the W portion of the K-W-L chart, students voted for four
questions that they wanted to Explore and teachers then planned lesson activities to facilitate that. After exploring the concepts, teachers planned further real-world scenarios for students to Elaborate their understanding of the concept. Students then completed the L (what they learned) portion of their K-W-L chart as an Evaluation of their learning and this was consolidated into an individual concept map for the topic. Teachers’ instruction of mathematical concepts as well as the worksheets and exercises typically used in these topics were integrated where appropriate.

The students were each equipped with a mobile phone that had apps enabling them to take photos, make sketches, draw concept maps as well as do postings on the school’s learning management system. These features of the phone were used to support students in the activities for Explore and Elaborate as they used multi-modal formats to express their understandings of mathematical concepts. Besides the phone, teachers also used the discussion forum on the school’s learning management system to share and consolidate students’ work. The teachers chose a mid-ability class comprising of 43 students to pilot-test these approaches. It was envisioned that these lessons will be implemented throughout the primary 3 classes during the following school year.

3.3 Data Collection and Analysis

Data was collected during the design meetings that teachers held from July to November 2013 where they discussed lesson ideas, drafted lesson plans and resources as well as reviewed video recordings of implemented lessons to make improvement. A total of ten audio recordings were made of these meetings that lasted between 1.5 to two hours each. The recordings were transcribed into text and further broken down by sentence as the unit of analysis. To answer the research question, content analysis (Weber, 1990) was used to code each sentence according to the seven TPACK constructs. During data coding, it was found that a second layer of codes explicating how the team shared, clarified, and justified ideas was needed to explicate the stage-by-stage TPACK transformations. Smith (1994) described these as group-mediated cognition to create and extend knowledge. To ascertain the reliability of coding and credibility of data analysis, a second rater reviewed the initial coding and discrepancies were negotiated till there was full agreement.

4. Findings

4.1 Pedagogical-related Transformations

To support the pedagogical change, teachers had to first transform their knowledge of pedagogical approaches for teaching math (PCK) and their pedagogical knowledge (PK). In the initial stages of the project, teachers were confronted with the need to create their own understandings of the 5E inquiry stages as the framework’s application in science may not be directly transferable to math. For example, in this discussion, teachers and a researcher discussed how to differentiate the “Explain” and “Elaborate” stages of the 5E inquiry process as they reviewed the design of a lesson activity (See Table 1).

Table 1 – Pedagogical-related Transformations

<table>
<thead>
<tr>
<th>Transcript</th>
<th>TPACK Transformations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Researcher</strong></td>
<td></td>
</tr>
<tr>
<td>a. In these two activities where the students need to make explanations, where does Explain stop and where does Elaborate start?</td>
<td>PK (Clarify)</td>
</tr>
<tr>
<td>b. What is your definition?</td>
<td>PK (Clarify)</td>
</tr>
<tr>
<td><strong>2. HOD – hmm… what is the difference?</strong></td>
<td>PK (Clarify)</td>
</tr>
<tr>
<td><strong>3. Researcher</strong></td>
<td></td>
</tr>
<tr>
<td>a. Does Elaborate mean that the student can explain the basic principles with more examples?</td>
<td>PK (Identify Gap)</td>
</tr>
<tr>
<td>b. I don’t see the difference between the two activities.</td>
<td>PK (Propose New idea)</td>
</tr>
<tr>
<td>c. You may want to review if you need both the stages or redefine them.</td>
<td></td>
</tr>
<tr>
<td>Transcript</td>
<td>TPACK Transformations</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>4. Math specialist – In science, Elaborate means that you explain the standard situation and be able to apply and extend it into different scenarios.</td>
<td>PK (State existing practice)</td>
</tr>
<tr>
<td>5. HOD</td>
<td></td>
</tr>
<tr>
<td>a. For math it is a bit difficult.</td>
<td></td>
</tr>
<tr>
<td>b. I would think [in fractions for example], Explain means that they can explain that fractions are made up of equal parts and be able to make comparisons.</td>
<td>PCK (Identify Gap)</td>
</tr>
<tr>
<td>c. Elaborate means that if they go to the ordering of fractions, they can explain how they make the comparisons.</td>
<td>PCK (Propose New idea)</td>
</tr>
<tr>
<td>6. Teacher A</td>
<td></td>
</tr>
<tr>
<td>a. I am thinking… can Explain mean that the students are able explain their thoughts and answers.</td>
<td>PK (Propose New idea)</td>
</tr>
<tr>
<td>b. Elaborate means to be able to draw conclusions from what has been discussed or to apply in a certain context.</td>
<td>PK (Propose New idea)</td>
</tr>
<tr>
<td>7. HOD – Which means they can use their explanations to extend to another situation.</td>
<td>PK (Refine new idea)</td>
</tr>
</tbody>
</table>

The above process of TPACK transformation began with the researcher seeking to clarify the team’s PK that is expressed in their design of the lesson activities (line 1a), which leads to a deeper question of possible gaps in their PK with respect to how they are envisioning the 5E stages (lines 1b, 2, 3a and 3b). The pedagogical-related transformations started in line 3c where the researcher suggested a new way of approaching this problem, which is an example of new PK. The team’s existing PK of how the Elaborate stage of 5E is being used in Science is reviewed in line 4 following which the HOD recognized a gap in their existing PCK (line 5a) and started to propose new kinds of lesson activities, which are examples of new PCK (lines 5b and 5c). Teacher A generalizes the HOD’s example as their team’s pedagogical definition, which is an example of new PK (lines 6a and 6b). The HOD further refines the PK expressed by Teacher A (line 7). Through this discussion, the team transformed their understanding of both PK and PCK to support the pedagogical aspects of their change.

4.2 Content-related Transformations

As teachers sought to deepen the students’ mathematical reasoning, they were confronted with the problem of how to better distinguish between different levels of mathematical reasoning. Teachers found that they needed to develop new Content Knowledge (CK) about mathematics. For example, for questions in fractions such as the one illustrated in Figure 1, teachers debated about the kinds of mathematical expressions that could be accepted as evidences of students’ mathematical reasoning.

![Figure 1. Sample math question on fractions.](image-url)
Table 2 shows a segment of this discussion.

**Table 2 – Content-related Transformations**

<table>
<thead>
<tr>
<th>Transcript</th>
<th>TPACK Transformations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teacher A</td>
<td>CK (Clarify)</td>
</tr>
<tr>
<td>a. What does a correct approach mean?</td>
<td></td>
</tr>
<tr>
<td>b. Draw and label the parts correctly?</td>
<td>CK (Clarify)</td>
</tr>
<tr>
<td>c. Eventually, are we talking about how detailed the drawing is?</td>
<td>CK (Clarify)</td>
</tr>
<tr>
<td>d. The different levels [of reasoning] have to be obvious because [the student] can draw, draw and label, or draw and label and explain</td>
<td>CK (New idea)</td>
</tr>
<tr>
<td>2. HOD</td>
<td>CK (Refine new idea)</td>
</tr>
<tr>
<td>a. Then the first level is to draw.</td>
<td>PCK (Support new idea)</td>
</tr>
<tr>
<td>b. Usually they (students) will shade.</td>
<td>CK (Refine new idea)</td>
</tr>
<tr>
<td>c. That is level 1.</td>
<td></td>
</tr>
<tr>
<td>3. Teacher A – Level 2 – draw and label all the parts.</td>
<td>CK (Refine new idea)</td>
</tr>
<tr>
<td>4. HOD</td>
<td>CK (Support new idea)</td>
</tr>
<tr>
<td>a. This is what we want to see.</td>
<td>PCK (Support new idea)</td>
</tr>
<tr>
<td>b. During their Primary 2 Summative Assessment II, a lot of them didn’t label.</td>
<td></td>
</tr>
<tr>
<td>5. Teacher C – Level 2 will then be to draw and shade and label all the parts.</td>
<td>CK (Refine new idea)</td>
</tr>
<tr>
<td>6. HOD – The shading is not the problem – need to label.</td>
<td>PCK (Support new idea)</td>
</tr>
<tr>
<td>7. Teacher A – If they explain [the wrong answer correctly] ... no marks for reasoning because it is wrong.</td>
<td>CK (Refine new idea)</td>
</tr>
<tr>
<td>8. HOD – [What] if explanation is clear?</td>
<td>CK (Clarify new idea)</td>
</tr>
<tr>
<td>9. Teacher D - Zero marks – [the] concept is wrong.</td>
<td>CK (Refine new idea)</td>
</tr>
</tbody>
</table>

Content-related transformation began with Teacher A seeking to clarify the team’s understanding of what it means to say that students have taken the correct approach to explicate their mathematical reasoning (lines 1a to 1c). She shares the conception of approaching the different kinds of expressions made by the student as levels (line 1d). This idea of “levels” is taken up and refined by the HOD who identifies the first level as drawing (lines 2a and 2c). She justifies her suggestion by using her knowledge of how students typically answered such kinds of math questions, which is her PCK (line 2b). The teachers and the HOD continue refining the idea by describing what they envision the different levels to be (lines 3c to 6). Along the way, the HOD supports the idea development by drawing upon her PCK of students’ test performance to emphasize how it can help teachers to better target students’ areas of weaknesses (lines 4b and 6). Lines 7 to 9 show the teachers refining their CK to include situations where students provide clear reasoning but had the wrong mathematical conception (lines 7 and 9).

4.3 Technological-related Transformations

In terms of technological-related transformations, Table 3 shows that it involves teachers clarifying their pedagogical conceptions of ICT use. This discussion occurred after teachers reviewed the implementation of a 5E lesson they designed to have students explore how the concept of equal parts in fractions were used in the design of national flags.

**Table 3 – Technological-related Transformations**

<table>
<thead>
<tr>
<th>Transcript</th>
<th>TPACK Transformations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HOD</td>
<td>TPK (Clarify) TPACK (Clarify)</td>
</tr>
<tr>
<td>a. Did we consolidate and collate their responses?</td>
<td></td>
</tr>
<tr>
<td>b. In our initial conception, we said that they could key their responses into the portal so that they can revisit their own or their friends’ answers.</td>
<td></td>
</tr>
<tr>
<td>Transcript</td>
<td>TPACK Transformations</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>c. Since they have so many responses, why don’t they key it in somewhere?</td>
<td>TPACK (Propose New idea)</td>
</tr>
<tr>
<td>d. They can use their phone or the laptop.</td>
<td>TK (Propose New idea)</td>
</tr>
</tbody>
</table>

2. Teacher A - There were two questions on the LMS forum for them to write their points about the flags. | TPACK (Clarify) |

3. HOD | TPACK (Clarify) |
| a. How about archiving their own responses? | TPACK (Refine new idea) |
| b. How about a GoogleDoc for each group? | TPACK (Support new idea) |
| c. It will be good to record their own learning, consolidate and share with their friends. | |

4. Teacher B – The problem with the phone is that students cannot access shared postings … even using GoogleDoc on the phone is quite hard | TK (Identify Gap) |

5. HOD | TPACK (Refine new idea) |
| a. For certain assignments, the students can use the phone but when they consolidate their learning they can use the laptop or desktop so that it is easy for them to read. | TPK (Identify new idea) |
| b. The forum cannot really help them to consolidate their learning. | TK (Identify Gap) |
| c. It just collates the postings and comments. | TPK (Identify Gap) |
| d. They won’t have an overall picture of their learning. | TPK (Identify Gap) |
| e. When they do their concept map later, it is not easy for them to revisit [what they have learnt about the topic] | TPACK (Gap) |

6. Teacher C – Is there anything that you can use to see the students’ responses immediately [in class]? | TK (Identify Gap) |

7. Teacher A – The Socrative app, but it does not allow posting of pictures and you can’t archive the responses. | TK (Identify Gap) |

8. HOD | TPACK (Refine new idea) |
| a. But that is only during the instance of posting but what I meant is that the students can [keep a] record their own learning. | TK (Refine new idea) |
| b. We highlighted the limitation of the phone but we can also explore beyond it. | |

9. Researcher | TK (Refine new idea) |
| a. How about online stickies? | TK (Justify new idea) |
| b. Teachers just need to set it up and the students can access with the URL as long as teachers don’t delete the canvas. | |

The HOD conceptualized ICT being used to compile the students’ responses to build knowledge as a community (lines 1a and 1b). These are aspects of TPK and TPACK that did not emerge in their implementation of lesson activities. She suggests new lesson ideas which are TPACK (line 1c) and proposed some tools that can be used (TK, line 1d). This idea was not picked up immediately as Teacher A clarified that they have collected the students’ ideas through forum postings (line 2). The HOD reiterates that the pedagogical idea (TPACK) is to use ICT for archival of personal learning and extension of learning by accessing the ideas of their learning community (lines 3a and line 3c). Teacher B raises another issue of the limitation of the current technology for supporting this new pedagogical aim (TK, line 4). The HOD refines her conception of TPACK by asking the team to consider how different technologies can support different kinds of math activities (line 5a). She makes general comments on the weaknesses of the forum as a personal space for archival and consolidation which is an example of the team articulating TK and TPK (lines 5b-5d). She then applies this knowledge to highlight the gap when applying it to a specific lesson activity of concept mapping (TPACK, line 5e). Teachers pick up the idea of using alternative technologies and explore their TK to
determine if there are any technologies that can help the teacher compile students’ responses in class (lines 6 and 7). The HOD refines her conception of ICT use (TPACK) by reminding teachers that the pedagogical aim is also for students to archive their own learning (line 8a) and reiterates that they need not limit their TK to their current ICT tools (line 8b). The researcher suggests new TK in terms of a possible ICT tool and explains its pedagogical affordances (lines 9a and 9b).

5. Discussion

The results of this study show that in school-based context, the design of pedagogical change occurs through a process whereby different forms of TPACK are being shared, clarified and extended. This is because such kinds of change tend to be what Rittel and Weber (1973) describe as wicked problems where the desired outcomes as well as the means of achieving these outcomes are not clear at the outset of the project and emerges through design. Current TPACK studies (e.g. Koehler, et al., 2007; Koh & Divaharan, 2011, 2013) describe the kinds of TPACK that teachers create at the beginning and end of ICT courses. This study extends the knowledge of TPACK creation by exemplifying how lesson ideas are progressively being created and refined. It also shows that TPACK transformations in the area of pedagogy, content, and technology are needed to support the design of pedagogical change. Even as teachers seek to make transformations in the technological aspect, it requires concurrent clarification of the pedagogical aims of the change before the role of ICT can be clearly ascertained. Correspondingly, pedagogical change can also redefine how teachers approach their current pedagogies as well as their content knowledge. They key features of TPACK transformations needed for pedagogical change are:

5.1 Problems and gaps as catalysts

From Tables 1 to 3, it can be seen that opportunities for TPACK transformation begin when the gaps of current practices are raised for clarification. These kinds of interactions set the directions for the team to approach their design of the problem solution. In design literature, designers’ conception of design problems are termed as design frames and reflection-in-action occurs as designers create and re-create frames as they evolve their problem solution (Cross, 2004; Schön, 1983). The study findings show that when the team is able to accept new frames and design ideas suggested within the team, it opens up opportunities for pedagogical change to emerge.

5.2 Iterative refinement

The findings of this study show that the ideas for pedagogical change are being refined progressively and iteratively. While the process of instructional design has been described as a systematic process with defined steps (e.g. Heinich, et al., 1999), the study findings support Laurillard (2012) and Summerville and Reid-Griffin’s (2008) findings that it is emergent and iterative. The findings also show that lesson design ideas become progressively clearer as its associated problems and gaps are being discussed and clarified. Therefore, the ability of team members to “spar” effectively with each other as well as the willingness to provide time for the emergence of ideas are also important elements that facilitate TPACK transformations during pedagogical change.

5.3 Building on teachers’ routine expertise

It can be seen that teachers’ PCK played an important role in moving the design process forward in technological, pedagogical, and content transformations. Teachers’ existing knowledge of students and classrooms are being used as epistemic resources to evaluate the possible success or failure of their design ideas. These findings show that for design to be effective, teachers’ routine expertise needs to be tapped. Yet, a challenge of design is how teachers can be facilitated to make epistemic leaps beyond their routine expertise (Marra, 2005).
6. Limitations and Future Research

This study is limited to a primary school and a team of six teachers who were working on a math project. As the team was working on the project centered upon the adoption of a pedagogical approach, this might have influenced the findings. Therefore, the findings still need to be verified in different kinds of pedagogical change projects as well as with teachers designing for different subject areas, as well as in secondary and higher levels.

In this study, we examined the teachers’ design talk. The talk could be further verified with teachers through interviews to improve the credibility of the study. In this study, researchers and a math specialist were also involved. This could have influenced the direction of the design decisions. In future studies, an area of study would be to examine the differences in pedagogical transformations with and without the inclusion of external parties could be compared. In addition, the relationships between design talk and effectiveness of implementation could be further correlated and examined in future studies. These kinds of studies could be used to derive guidelines on how design talk for pedagogical change could be better facilitated in school-based design teams to derive the educational outcomes they desire.

7. Conclusion

Windschitl (2002) observed that when teachers are not able to achieve deep pedagogical understanding, the kinds of pedagogical change that emerge from their design are typically characterized by surface level changes. A better understanding of teachers’ design talk as well as how TPACK transformations can be better facilitated in team-based settings is one way of addressing this issue. These areas are worthy of more extensive study in future studies.

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References


Professional Development of Teachers in a MOOC

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Abstract: In this paper, we describe the participation in a MOOC which was arranged by and for teachers in Sweden. The MOOC was organized as a community rather than a course, which meant that there was a skeletal structure to facilitate community engagement but no set learning goals or tasks that had to be done by the participants. This loose structure enables participants to attend to the MOOC in different ways. Based on answers to surveys, four ways of participation are mapped out in this article. The structure of the MOOC was based on connectivist notions of knowledge building and the central principals of autonomy, diversity, openness and interactivity. How connectivist thinking can be related to the participation in the MOOC is explored and tensions between the two are discussed. The importance of dialogue in order to develop connections for learning is an aspect which is regarded as important in this article. As professional development for teachers, the MOOC has both advantages and disadvantages. The openness of the MOOC is considered an advantage by some participants, but an obstacle by others. The openness means a flexibility of when and to what extent to participate, but it also creates an uncertainty of what is expected and how to participate.

Keywords: MOOC, professional development, participation

1. Introduction

In recent years MOOCs have captured the attention as a new way of gaining knowledge and competencies, and they have been portrayed both as a threat and an opportunity to conventional education (e.g. Beaven, 2013). This article concerns a recently held MOOC in Sweden which aimed to raise teachers’ digital and social media competencies.

During the autumn of 2013 \textit{Digitala skollyftet}, was created as a cMOOC, based on the philosophy of connectivism and networking (cf. Siemens, 2005; Downes, 2008) designed by and for teachers. Four teachers, who have previously been involved in another initiative called \textit{Skollyftet} in Sweden, set up the site and planned for the MOOC which started in November 2013. Setting up \textit{Digitala skollyftet} can be seen as an attempt by the teachers behind \textit{Skollyftet} to contribute to raising the digital competence amongst teachers in Swedish schools. The project aimed at addressing three cornerstones; digital competence, sharing-is-caring and school development.

\textit{Skollyftet} originates in an attempt to counteract negative media coverage of Swedish schools and attempts to emphasize positive aspects and changes in the Swedish educational system. \textit{Skollyftet} has become quite well-known amongst teachers in Sweden. On Twitter there are several active teachers who post information and discuss school issues. Every Thursday night there is an hour-long discussion on a particular subject in what is called #skolchatt. These phenomena where teachers actively engage in social media and discuss educational issues with colleagues throughout the country have been termed the Online Community of Educators (\textit{det Utvidgade Kollegiet}).

\textit{Digitala skollyftet} was designed as a cMOOC which means that the focus was on community building and interaction (Jobe, Östlund & Svensson, 2014). Most MOOCs are xMOOCs, similar to traditional academic courses and have a clear structure with a set starting and finishing point. Since MOOCs are not very common in Sweden, particularly not cMOOCs, there was a general concern amongst the organizers that the participants may need some sort of structure to get involved.
Therefore, a starting point in November 2013 was established and weekly hangouts were arranged where different issues were discussed and “experts” were invited to take part in the discussions. Digitala skollyftet was constructed with a connectivist pedagogical model in mind but had a skeletal structure in order to scaffold the involvement of participants.

1.1 Digitala skollyftet

Around 1,500 persons enrolled in Digitala skollyftet. However, to enrol in a MOOC, particularly a cMOOC, does not mean committing to anything. To enrol is free and open and there are no predefined expectations for participation (McAuley et al., 2010). Since the MOOC is open, participation is possible whether being enrolled or not. Therefore, the number of people who enrolled has little, or no, relation to the number of active participants. As McAuley, Stewart, Siement and Cormier (2010) put it “participation in a MOOC is emergent, fragmented, diffuse, and diverse” (p. 6).

Digitala skollyftet aimed to facilitate user engagement and the loose structure of the course contained suggestions of weekly tasks which the participants could engage in. For example, in the first week the task consisted of presenting yourself online and commenting on someone else’s presentation of themselves. The participants were to choose a forum in which to present themselves and they also make attempts at finding other participants in digital environments and social networks. The MOOC was based on user engagement, offering a number of online tasks in which the participants could engage actively by interacting with others, contributing with posts in digital environments and social networks such as Twitter and Facebook, as well as setting up their own blog. However, participation in a cMOOC like this does not necessarily mean actively interacting and posting, but could also consist of following the flow of events connected to the MOOC and receiving information through others by reading what they post and following discussions in different forums.

The aim of this article is to investigate the activities taking place in a MOOC designed as a space for professional development of teachers. The article will map out the nature of the interaction and what it means to participate in a space that has a clear professional focus, with a structure that aims to build a community based on the connectivist principles of autonomy, diversity, openness and interactivity.

2. Theoretical framing

The theoretical framing of this article is based on an extended notion of the connectivist perspective, where interactive dialogic practices are foregrounded. cMOOCs are often associated with connectivist perspectives on learning (e.g. Bell, 2011) and connectivist approaches to learning are frequently expressed as the ability to see connections between fields, ideas and concepts, connecting information sources (Siemens, 2005). However, Ravenscroft (2011) argues that mechanisms for maintaining connections take place through dialogue: “a pivotal role for dialogue interaction in meaning making and learning within networks and similar open enterprises” (p. 140). From this perspective, connectivism is suggested to have evolved having an emphasis on dialogue since networking means collaborative thinking.

To some extent, Digitala skollyftet resembles the MOOC Connectivism and Connective Knowledge (CCK08) since both explore connectivist notions of knowledge building. In previous articles (Mackness, Mak & Williams, 2010; Mak, Williams & Mackness, 2010) the participants’ learning experiences in CCK08 have been explored in relation to the connectivist principles of autonomy, diversity, openness, and connectedness and interactivity (e.g. Downes, 2008). ‘Autonomy’ here refers to that learners are allowed a choice of where, when, how, with whom, and even what to learn. ‘Diversity’ is related to there being a diverse population in order to avoid group-thinking and ‘echo-chambers’ (McRae, 2006). ‘Openness’ concerns the free flow of information and is supposed to encourage a culture of sharing and a focus on knowledge creation (Mackness et al., 2010). ‘Connectedness’ and interactivity is considered to be what makes all this possible. Knowledge emerges as a result of connections, according to the connectivist perspective (e.g. Bell, 2011). Though

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1 The MOOC Guide: https://sites.google.com/site/themoocguide/3-cck08---the-distributed-course
the CCK08 contained the connectivist principles, paradoxes also arose which constrained “the possibility of having the positive experiences of autonomy, diversity, openness and connectedness/interactivity normally expected of an online network” (Mackness et al., 2010). It could therefore be put into question whether it is possible to combine the connectivist principles, which are based on online networks, to MOOCs as courses. To emphasize the network aspects, and perhaps downplay the course aspects, the organisers of *digitala skollyftet* tended to refer to the MOOC as a Massive Open Online Community, rather than Course.

To frame participatory activities, Goffman’s (1959) uses the concept of presentation of self as a tool to identify user interaction. For activities of participation, online performance has been used in investigating notions of what Goffman would label front stage and back stage activities (Hogan, 2010). However, as Hogan (ibid.) points out, Goffman’s dramaturgical approach focuses on situations which are framed in time and space. Online environments, on the other hand, are often asynchronous and less dependent on time and space. Hogan (ibid.) distinguishes between performance spaces online where actors perform with each other and exhibition spaces where artifacts will be submitted by individuals in order to show to others. This distinction will be used to identify different ways in which it is possible to participate in MOOCs like *Digitala skollyftet*.

3. Methods

The method for collecting data incorporates a number of different datasets which will be synthesized in the analysis in order to illuminate different aspects of participating in the MOOC as well as of particular aspects of it, such as badges.

The empirical data consist of three surveys as well as interviews with the organizers of the MOOC and with some participants. Open online resources, such as blogs, Twitter, and Facebook, have also been mined for data which concern *Digitala skollyftet*. For example, data have been collected from mid October 2013 until the end of March 2014 from twitter, where the hashtag #digiskol has been used. Collecting data from social media is notoriously difficult and an area of research which is still very much at an exploratory stage of how to collect and analyse data (Horst & Miller, 2012), as well as ethical aspects of how to use data (Ess, 2011).

A first survey was sent out to those who had enrolled in *Digitala skollyftet*. This survey mainly asked for basic information of the participants, such as if they were teachers and which subject they taught and at what level. 438 persons answered this initial survey and above 80% of them agreed to participate in further investigations. The background information showed that the participants represented all levels of the school system. The number of female participants greatly outnumbered the number of male participants. In this survey the respondents were also asked whether they agreed to answering more surveys, whether they agreed to be interviewed and whether they agreed to possible visits by the researchers at their workplace. In the survey it was clearly stated that interviews and visits would only be made with a small number of the participants and, even if they agreed at this point in time, they have the right to withdraw their participation at any time. A second survey, with in-depth questions regarding the participants’ use of digital technology and social media within their profession and in their spare time was sent out in the beginning of January 2014. This was a rather extensive survey which took some time to complete. A third survey was sent out in March 2014. This survey was shorter and the questions concerned the participants’ experiences of the MOOC. The questions were open-ended and therefore a qualitative approach at interpreting the answers has been taken (see Appendix 1). All in all, 66 persons answered all three surveys and 10 of these persons were also awarded the *Digitala skollyftet* open badge.

The analyses in this paper primarily concern the 66 persons who have answered the three surveys. Their answers in survey three with open ended questions have been analysed and the participants have been organized in four groups based on their answers regarding their activity in the MOOC. These four groups have been compared in order to find characteristics of participation. These characteristics are then analysed in relation to the connectivist principles of autonomy, diversity, openness and connectedness/interactivity in order to notice similarities as well as differences in how the different groups relate to these principles and to detect how the principles relate to the participation in a MOOC.
4. Findings

In this section, the findings are presented starting with some general indications in the answers from survey three (see Appendix 1). This is followed by a description of four groups of participants based on characteristics of the participation, as detected in the data. Finally, the general indications as well as the groups and their participation is analysed in relation to the four connectivist principles. This analysis aims to illuminate how these principles relate to participation in a MOOC, as well as to highlight potential paradoxes and dilemmas which become noticeable when relating the principles to participation in a MOOC.

4.1 General indications

A great majority of the participants regard *Digitala skollyftet* as a good way to develop their professional competence. Only four of the 66 participants state that they are negative towards *Digitala skollyftet*. Three of these four work at preschool-level which indicates that *Digitala skollyftet* may not have been particularly suitable for this level of the educational system. As one of them states “it is all about school, school, school”. Though being positive generally, a number of participants raise issues about working too much and working on their spare time. If partaking in *Digitala skollyftet* is considered to be part of their professional development, then these participants state that it should be done within working hours. The importance of gaining approval from their headmaster in order to get time to engage in this sort of competence development is stressed.

When asking about their use of digital tools and whether that has changed due to their engagement in *Digitala skollyftet* a majority answer that it has changed. Many mention different tools that they have discovered and/or started to use, but many also state that they have come in contact with other people and through them started using other tools. 7 persons write that it has not changed their use of digital tools at all and 13 persons state that they were already competent and frequent users and therefore their use of tools has not changed to any considerable extent. The people who appear to have changed their use of digital tools the least are a group which, on the one hand, consist of those who did not engage in *Digitala skollyftet*, and, on the other hand, a group which could be considered highly competent users already. Those who benefit the most therefore seem to be a group in the middle who actively engaged in *Digitala skollyftet* and who had some experience in using digital tools but who could not be considered expert users.

A majority of the participants state that engaging in *Digitala skollyftet* has made a positive difference to developing their network. A handful write that they cannot tell, since they did not participated to any large extent and the same number say that *Digitala skollyftet* has not developed their network. Two of these participants, question the use of Facebook and Twitter and consider participation in *Digitala Skollyftet* to be too dependent on these specific environments.

When it comes to whether their engagement in *Digitala Skollyftet* has contributed to school development, more than 10 persons are uncertain or write that it has not. One of them writes that it is difficult to know since school development is a long term process. Sharing the information they received through *Digitala Skollyftet*, as well as being able to convince their headmaster of the importance of digital competence, are ways that are stated as contributing to school development. There appears to be a difference in the way school development is conceived. Some participants see their individual development as school development, or whereas others regard school development as referring to a more systemic level of the organization.

A majority of the participants say that they share material and for many that was something which they did before *Digitala Skollyftet*, so therefore their attitudes towards sharing have not changed. However, some write that they now dare to share or that they are starting to consider it. One person state that sharing makes the work as a teacher more fun as the climate at his/her workplace is “rather heavy”. Another one found it hard to find teachers who shared online and who worked at the same level in the educational system, therefore it was hard to find relevant material and/or people to cooperate with.
More than ten participants state that their engagement in Digitala Skollyftet has contributed very little, or not at all, to changing how they work in the classroom. Most of them state that this is because they did not engage in Digitala Skollyftet as much as they had planned, but some also write that they are planning to change things but have not yet done so. The changes mentioned mainly relate to the increased use of different digital tools.

Most of the participants see the openness of Digitala Skollyftet as something positive which enables them to engage in the MOOC when they have time and at their level. However, this could also be negative since other engagements may be prioritized when there are no deadlines to met. The openness also lead to insecurity about what you were expected to do and how. Some point out the difficulty in grasping the extent of Digitala Skollyftet. A couple of people state that it was hard to find people to collaborate with and one mentions that it appears as though the cooperation mainly takes place within previously existing networks. It is also mentioned that more support may be needed if you are new in this type of environment. This indicates that newcomers may find it difficult to find out how and with whom to collaborate and share ideas and material. The openness then becomes a restriction.

Only a handful of people consider Digitala Skollyftet as finished, instead the majority view it as a start and emphasize that school development is a continual process without end. This indicates that Digitala Skollyftet is regarded as school development and not primarily as personal development.

4.2 Four groups of participants

Four groups have been distinguished in the empirical material based on their participation in Digitala skollyftet. These four groups will be presented here and the characteristics of each group will be explored and explained. The four groups are categorised as follows:

- the posting participants (21 persons),
- the on-looking participants (16 persons),
- the constrained participants (17 persons),
- the non-participants (12 persons)

The distinction between the groups are not clear-cut, particular not between the two middle groups of on-looking and constrained participants as these two groups are similar in that they have participated in Digitala skollyftet, but not consistently or as on-lookers. In all four groups, there are representatives from different levels of the school system. The number of males and females in the groups mirrors the larger representation of females which was found in the initial survey.

“The posting participants” is the group that portray themselves as active participants in Digitala Skollyftet. They have contributed to discussions in different forums and shared their material with others. Half of the group (10 people) have also been awarded a Digitala Skollyftet-badge. In order to receive the badge they had to give evidence of their competence in the three cornerstones; digital competence, sharing-is-caring and school development. Though this group is positive towards Digitala Skollyftet about half of them also raise critical issues regarding the loose structure of the course and that it was hard to grasp and understand what to do and how to perform the tasks. Some of them consider the difference in experience of the participants to be somewhat problematic. Whereas a couple of them write that they had expected a higher level on the assignments, a few others write about the obstacles for newcomers to participate in the MOOC. All but one of the participants in this group, write that they share material and ideas with others. A couple of them appear to share mainly with external colleagues since they claim not to get much response from the colleagues at their workplace. One of them writes that social media has become a breathing space, in which to communicate with equally engaged colleagues. A number of participants in this group appear to focus their involvement around certain interests such as flipped classrooms and coding. This could be a strategy to narrow the focus of participation in order to cope with the expansiveness of Digitala Skollyftet.

The persons in “the constrained participants” group state that they have not engaged in Digitala Skollyftet as much as they had liked to, or planned to do. Most of them write that they started off being active and engaged but then their everyday work as teachers took most of their time and due
to time constraints they have not participated in the way they intended. Overall this group appears to be active, though not consistently, and most of them write that they actively share material with others, though some state that they are still a bit reluctant to do that. Though they have not been as actively engaged in Digitala Skollyftet as they had planned, most of them still claim that they have changed their way of working in the classroom by using new or different digital tools. They also express that their network of colleagues have expanded and that they have found new persons and blogs to follow and get ideas and practical suggestions from. Some of them state that their engagement in Digitala Skollyftet has enabled them to support colleagues at their workplace in developing competencies regarding digital tools and sharing with others.

“The onlooking participants” are characterized by their engagement in Digitala Skollyftet mainly consisting of reading what others have posted in different forums and on blogs. These participants do not, to any great extent, post and share their own material and they are therefore less visible as active participants compared to those who post and share actively. In the descriptions of their engagement in Digitala Skollyftet, they appear to be active in the sense that they read blogs and follow Facebook-groups and discussions on Twitter. This is a source of information and inspiration, which is then shared by some with colleagues at their workplace. Some of them try out new digital tools in their classrooms and some consider their involvement in Digitala Skollyftet as leading to school development when they spread what they have learned through reading and following activities in different forums. When referring to the Online Community of Educators (det Utvidgade Kollegiet) they mainly appear to see the community as a resource. However, most of them are reluctant to share themselves, even though some say that they either do, they are starting to do it, or consider doing it. A couple of the participants in this group state that the openness enables them to participate in their own way so that even if they are not posting or actively participating in discussions, they are able to follow them in their own time.

“The non-participants” have not engaged in Digitala Skollyftet to any considerable extent. Half of the group, 6 persons, says that they did not participate due to changes in work or family issues. However, 4 of these express that they see Digitala Skollyftet as a good way to develop professionally. A couple of the others write that they did not have the necessary tools to be able to participate and two of them say that they were not allowed to participate due to lack of communication and since they did not understand what they were supposed to do, or how. This indicates that these persons belong to those who would have needed more support in order to be able to participate.

The characterizations of the different groups are based on how they portray their participation when answering the third survey. This portrayal can be compared to how they answered questions about their activity in social media in the first and second survey, as well as to their actual activity on for example Twitter during Digitala Skollyftet. In the first two surveys “the posting participants” and “the constrained participants” state that they are active in social media to roughly the same extent. However, their activity on Twitter convey that “the posting participants” are more active since they both post more tweets, retweet more and have a larger number of followers as well as the number they follow.

4.3 Connectivist principles and participation in Digitala Skollyftet

In this section the participation in Digitala Skollyftet will be considered in relation to the connectivist principles of autonomy, diversity, openness and connectedness/interactivity. These principles connect and influence each other and their interconnectedness is therefore in focus rather than each principle on its own. The findings in earlier studies of the CCK08 (Mackness et al., 2010, Mak et al., 2010) will be related to since both this MOOC and Digitala Skollyftet could be called cMOOCs.

Mackness et al. (2010) write that the participants in CCK08 equated autonomy to “flexibility and control over learning and exemplified by the participants’ choices of how, and how much, to engage with the course” (p. 269). This corresponds to a large extent to what the participants in Digitala Skollyftet consider to be the advantage of the MOOC. However, the participants in Digitala Skollyftet also saw this flexibility, together with the openness of the course, as one of the obstacles for active participation. The need for guidance was stressed by several participants and some stated that their reason for not participating was the open structure, or lack of structure and support. The openness was regarded as an obstacle since the participants became uncertain of what was expected of
them, but also as an asset since the way they participated became more flexible. Mackness et al. (2010) state that in CCK08, openness was implicitly referred to as a way of being. The participants in Digitala Skollyftet similarly seem to equate openness and the inclination to share as a positive personal asset which many of them claim to have or, if not, then aspire to acquire.

When it comes to diversity, this could be considered from two different aspects. Many participants stated the fact that they could connect to colleagues who worked in different environments and different parts of the country as something positive. Professional development of teachers commonly takes place within a particular school or maybe together with neighbouring schools. In that sense Digitala Skollyftet offers diversity. On the other hand, it is discernible in the data that many participants were mainly interested in connecting with people who in some sense were similar to themselves. To collaborate with someone it was often stated that the other person(s) needed to teach the same subject and/or teach at the same level of the school system. In that sense diversity was not something that the participants sought in Digitala Skollyftet. Since the MOOC was intended for teachers in Sweden it could also be argued that this group in itself is not homogenous enough to enable the kind of diversity aimed at in MOOCs. Instead, what McRae (2006) refers to as group-thinking and ‘echo-chambers’ may be encouraged.

Although the participants in Digitala Skollyftet consider the autonomy and flexibility of to what extent and how they engage in the MOOC as important, their actual engagement in Digitala Skollyftet is characterized by their interactivity with others. The importance of digital dialogues, as pointed out by Ravenscroft (2011), becomes apparent since to follow others on Twitter and on blogs is by many regarded as a key feature in their own development. The notion of “sharing-is-caring” closely relates to this interconnectedness and stresses the community, rather than the individual, as important. The activities of the participants on Twitter convey this interactivity and also explicate the importance of certain actors. The organisers of Digitala Skollyftet are central in these activities as many of the participants turn to them when they have questions, but also since they to a certain extent moderate the course by supporting participants in different ways. For example, they retweet when somebody asks a question or enquires about possible cooperation, or they attempt to put people in touch with each other who have not yet “connected” on Twitter. Figures 1-4 attempt to visualize the network of participants from the different groups. The visualizations depict the activity on Twitter under the hashtag #digiskol during the period of October 2013 to March 2014. Figure 1 shows the network of the non-active participants (marked with red). As shown, these participants have few contacts. Some are in contact with the organizers (marked with turquoise) and also with the Twitter alias @digiskol and @skollyftet (marked with blue). The activity of the on-lookers is depicted in figure 2. The on-lookers (marked with yellow) are connected to each other through their contact with the organisers as well as through @digiskol and @skollyftet. The amount of contacts varies and so do their connectedness to others in the group. Figure 3 shows the activity of the constrained participants. Their networks are intertwined through the interaction with the organizers, @digiskol and @skollyftet. Some of the on-lookers appear to have more contacts than the constrained participants. This could be because the on-lookers mainly collect information and in order to receive a substantial amount of information they have a larger network. The posting participants have vaster networks than the other three groups, as shown in figure 4 (marked with green). However, in all the groups, the organisers, @digiskol and @skollyftet are important nodes in the networks.

Apart from the organisers, other experienced users of Twitter with large networks of followers may become important to newcomers. In this way some participants may take on, or be given, the role of an expert. Though the building of a community of peers may be the vision of a MOOC, the reality may be that the occurrence of more-capable peers in networks are inevitable. However, this should not be seen as negative, but rather as a way in which participants learn from

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2 The size of the circles in the figures visualizes the amount of interaction, as in mentions, sent to and from participants. Larger circles mean that a larger amount of tweets with mentions have been sent. The sizes of the circles should be considered within each figure as the scale of the figures had to be adjusted so that all became visible but were not too large.

The size of the arrows in the figures relates to the number of tweets with mentions. The alias where the arrow originates from has sent a mention to the alias which the arrow points to. An arrow pointing at a circle means that tweets have been sent which mentions the alias of this circle.
each other and where more-capable peers can be regarded as assets since they may scaffold the experiences of the newcomers.

According to connectivist views, learning flows from an initial connection (e.g. Siemens, 2005). However, as pointed out by Mackness et al. (2010) “connectivity itself is not a sufficient condition for connectedness or interactivity” (p. 272). To achieve meaningful connectedness is difficult and this difficulty may partly be related to the relation between a MOOC and the connectivist principles (ibid.). To connect digitally with others is one thing, but in order to investigate how these connections may evolve and become spaces for learning, attention needs to be paid to the dialogues that the connections facilitate (Ravenscroft, 2011).

5. Conclusion

To sum up, it is possible to see that the Digitala skolbyftet is an active environment, displaying interaction on different levels. Four categories of participation were discerned, which all show ways
of engaging in this type of MOOC. Digitala skollyftet can be considered as professional development for teachers. The different ways of participating in the MOOC disclose that the openness of the MOOC is both an obstacle and an asset. Posting participants, who generally are experienced users of social media, as well as non-participants, who generally are less experienced in digital surroundings, state that the openness contributed to an uncertainty of what was expected of them when taking part in the Digitala skollyftet. That it was difficult to grasp the extent of the course added to their uncertainty.

Comparing the four different groups of participants it is possible to discern differences in how and with whom they engage. The visualizations in figure 1-4 attempts to show that the extent of their networks are different. What is similar in the networks of all groups is that the organisers of the MOOC, @digiskol and @skollyftet are important nodes in the networks. The posting participants have a wider network, which, to some extent, is separate from Digitala skollyftet. One reason for this may be that their networks have been developed before the MOOC. For some of the constrained and on-looking participants, the building of a network started with their participation in Digitala skollyftet and is therefore intimately connected to the MOOC. However, the participants in these two groups also appear to closely relate their activities in the Digitala skollyftet to the local context of the school where they work. The importance of sharing what they have discovered through Digitala skollyftet with their colleagues at work is emphasized more by these groups than by the posting participants. The participation of the constrained and on-looking group may therefore contribute to the professional development of the participants as well as their local colleagues. The different groups of participants reveal different ways of engaging with the MOOC. However, whether there is a preferred way of engaging with the MOOC is, according to us, not possible to discern. Instead, how participants chose to engage in the MOOC is likely to depend on their personal reasons for participating and their professional development also relate to what they wish to achieve and in which areas. Since the MOOC is open and diversified, what participants gain from engaging in it is likely to become equally open and diversified. As cMOOCs are not supposed to have preconceived fixed goals, it is largely up to each and every participant to decide their own path. However, if learning is seen as social in nature and depends on the engagement with others, then what kind of interaction between participants the MOOC renders possible are crucial in order for spaces for learning to evolve To facilitate the performance of qualitative interactions rather than the exhibition and sharing of artifacts, scaffolding may to a larger extent be needed in a MOOC.

The connectivist principles of autonomy, diversity, openness and connectedness/interactivity have a bearing on the way the participants engage in the MOOC. However, questions could be raised as to what extent the connectedness facilitated by the MOOC also facilitates spaces of learning. The nature of the interactions, whether analog or digital, is crucial if MOOCs are to become spaces for learning. Therefore, Ravenscroft (2011) write that connectivist thoughts need to consider the importance of dialogue. He stresses the need for dialogues to facilitate critical inquiry, reflection and negotiation. Some of the participants in Digitala skollyftet stress the need to be able to further discuss issues. This appears to be done by some participants when they share their experiences in the MOOC with colleagues at the school where they work. For these participants the MOOC becomes a vehicle for finding information and sharing with others, but deeper engagements in subjects are carried out through dialogues in local contexts. This connects to Hogan’s (2010) notions of performance and exhibition spaces. With the current structure, the MOOC appears to mainly facilitate the exhibition and sharing of artifacts. In order to become a performance space where participants engage with others, a structure of the MOOC which supports such dialogues may be needed. The purpose of the structure would be to facilitate deeper engagement by supporting critical inquiry, reflection and negotiation. Such a structure may overcome the difficulty to achieve meaningful connectedness (Mackness et al., 2010) since it addresses the differences between networks in general and MOOCs as networks which facilitate learning.

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Appendix 1

Questions in survey 3

- How would you describe your participation in Digitala Skollyfet?
- In what way has your participation in Digitala Skollyfet contributed to changing your use of digital resources?
- In what way has your participation in Digitala Skollyfet contributed to the development of your network?
- In what way has your participation in Digitala Skollyfet contributed to school development?
- How has your participation in Digitala Skollyfet altered your views on sharing on the Internet?
- In what way has Digitala Skollyfet contributed to changes in the classroom? Please give concrete examples!
- What advantages and disadvantages do you see with this kind of “course structure”?
- How do you evaluate Digitala Skollyfet as professional development?
- Do you consider Digitala Skollyfet to be finished?
- General comments about the course
Teachers’ Perceptions of E-Learning in Malaysian Secondary Schools

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Abstract: Malaysian teachers are constantly bombarded with many new technologies that are believed to be able to help them perform their job better. Since 2013, they have been given access to an online learning space known as the FROG VLE. However, initial evidence has shown poor adoption of the e-learning. As schools are becoming increasingly disconnected from the societies of which they are a part, teachers withdrawing into their old familiar landscapes of teaching and learning can no longer be accepted. Being the implementers in the classrooms, their perceptions’ towards any innovation are important if the innovation is to be taken up seriously and to be implemented. Measures to improve present condition in order to sustain and increase e-learning uptake, can only be carried out if we know the situations and conditions teachers are in. A qualitative approach was used to identify the views and experiences of 60 secondary school teachers towards the implementation and continued use of VLEs in three secondary schools in Malaysia. Data was collected using an open-ended questionnaire. The results among others, share benefits experienced by the teachers, identified main barriers they faced and suggestions to better improve the implementation.

Keywords: E-learning, blended learning, perceptions, secondary school education, teachers

1. Introduction

By 2019, 50 percent of all high school courses are predicted to be delivered in an online format (Horn and Staker, 2011). Education will be revolutionised by making it more accessible and individualised (Christensen, Horn & Johnson, 2011). To keep pace with the growth of e-learning education in Malaysia, there is a pressing need to conduct relevant research in this area. This paper presents the results of a recent study we conducted on the FROG VLE in three secondary schools from two states in Malaysia. FROG VLE is the government’s initiative to leverage ICT usage in all its primary and secondary schools in the country. Previous initiative, to increase ICT usage in schools known as the Smart Schools project despite having consumed massive expenditure, found that 80% of the teachers used ICT less than one hour per week, and this was also mostly limited to word-processing (UNESCO, 2013). Other researchers have also argued that computer usage in schools are limited and in some cases almost non-existent (Koustourakis & Panayiotakopoulos, 2008). To benefit from the latest innovation introduced in schools, early intervention programmes are needed to prevent similar poor results. Therefore, teachers’ early perceptions of the FROG VLE are crucial for ongoing assessment plus intervention programmes to be carried out as problems emerged are identified and solved. In order to facilitate effective e-learning, the benefits as well as the barriers to implementation must be understood. Thus, three research questions guided this study:

1. What are the benefits of e-learning for teaching as perceived by teachers?
2. What are the barriers of e-learning implementation as perceived by teachers?
3. What suggestions do they have to improve the e-learning teaching and learning environment in schools?

The results of this study are expected to help better understand issues related to teaching and learning among the teachers when implementing e-learning in their classrooms and to provide implications for designing and delivering e-learning education and professional development courses. We believe the benefits are best articulated by those with first-hand experience using the e-learning in their classrooms. Those who have not implemented are likewise in a unique position to provide insights into the barriers that are preventing them from utilising the system. Suggestions for improving the e-learning teaching and learning were also sought in order to better understand teachers’ situations. The
implications are far reaching in our understanding of the e-learning’s role in supplementing and at times complimenting the face-to-face teaching and learning. The present study is part of a larger study in which factors that predict teachers’ satisfaction in the e-learning environment are also studied.

2. Literature Review

2.1 Learning Management System (LMS) in Malaysia

LMS is a software package that administers education and manages human resources. It supports e-learning activities such as presenting information, managing course materials, and running assessments (Yueh & Hsu, 2008). It offers teachers a number of benefits, like having the course management tools, group chat and discussion, assignment submission, course assessments, manage educational resources and also track student’s participation. Besides increasing interest among the teachers and learners, it also enhances teaching effectiveness and cost-saving (Yueh & Hsu, 2008). It provides support and enhances traditional ways of learning (Georgouli, Skalkidis & Guerreiro, 2008). Various terminologies are also used to describe the LMS, for instance Course management System (CMC), Learning Content Management System (LCMS), Computer-based Learning and Online Learning. At present there are several LMS applications in the market like Moodle, Blackboard, Etutor, eFront amongst many others.

E-learning is becoming an important long-term strategy for many educational institutions. Given the rapid growth and its importance, quality e-learning environment is highly required. The one person who would be at the forefront of the online delivery is the teacher. As such, training and support for teachers are important components of an e-learning education. This is in relation to the different roles that teachers would be playing in an e-learning environment. The transition from face-to-face to an online setting requires relevant and effectively planned professional development courses. Are teachers ready to meet the challenges brought by the increase in demand for e-learning? A study carried out by Kim and Bonk (2006) found that most of their respondents believed that monetary, pedagogical and technical competency are some of the more important factors that affect the success of any e-learning initiatives. Instructors’ abilities, skills and commitment to teach online are critical to the success of any e-learning. Their willingness to adopt is also an important consideration. Instructors’ pedagogical conceptions and values often do not include using ICT as part of their teaching and learning process. Continual management of the e-course also makes the instructors’ work time-consuming. Teachers perceptions of extensive time required are the key obstacle to e-learning. More time is felt needed to plan, create and maintain a course and to motivate and spark interest among students to work online are just some of the many challenges to successful implementation. Their level of personal innovativeness also to a large extent will determine if they will take the extra steps to experiment and implement any new innovation.

In Malaysia, recent development has seen the launched of the Malaysian Education Blueprint which is a detailed plan of action that maps out the education landscape for the next 13 years (2013-2025). Realising the gap towards producing a more technologically literate workforce, one that is relevant to the 21st century knowledge and skills, it has identified 11 shifts that will need to occur to deliver the change in education outcomes envisioned by all Malaysians. The National Education Blueprint emphasizes effort to leverage ICT in order to improve the quality of learning across the country. Twenty five initiatives have been identified under the first wave of the Malaysian Education Blueprint (2013-2015). One of them includes providing 1BestariNet and software for schools. 1BestariNet is a project led by the Ministry of Education (MOE) to provide access to a cloud-based virtual learning platform known as the FROG VLE (adopted from United Kingdom) and high-speed connectivity by June 2014 to all the 10,000 fully-aided government schools. 1BestariNet is to replace Schoolnet which was launched in 2004. Schoolnet fell short of expectations, especially in terms of speed (only 1Mbps), capacity and lack of specifications and integration. This ambitious technology-in-education project will cost Malaysian taxpayers RM1.5 billion (nearly US$500 million) and its implementation is expected to run over 13 years. 1BestariNet IDs has been made available to all students, parents and teachers in all the schools nationwide, where they now have single-sign-on access to the Frog Virtual Learning Environment (VLE), Google Apps for Education and the FrogStore. Through the Frog VLE, teachers are able to digitize their teaching content and explore new ways of bringing the best resources and teaching methods to be shared across
the 10,000 schools. Learning anytime, anywhere is now possible with free Internet access available to all 10 million teachers, students and parents in the schools in Malaysia.

2.2 New Pedagogy and Technology for E-Learning Educators

Stepping into any classrooms today is almost the same as stepping into any classrooms 20 years ago. Although technology is used in every aspect of our students’ lives, the same does not happen in the classrooms. Instead, in schools computing is an organised event, scheduled according to the convenience of timetabling. The gap between what students can do with technology and allowed to do with it in school is expanding with each passing day. Teacher Professional Development Courses, trainings, workshops and in-house sharing have been less than successful in helping teachers to be motivated to integrate technology for teaching and learning. School leadership is often not able to provide strong leadership and strong support due to their own lack of technological knowledge and experience. Even new teachers, whom the school communities looked up for guidance on technology use, hardly infuse technology into their own classrooms. Current teacher preparatory programmes are not effective enough in equipping these new teachers with the much needed skills and knowledge that are required to transform today’s classrooms. They are just not taught to handle effective infusion of technology in all subject areas. Lacking in widespread support and professional development, existing teachers are not able to make the necessary changes to their classroom practices. Even the enthusiastic ones with high level of expertise may give up due to the barriers they faced. However, the fact remains that learning to teach and learn in new ways with technology is no small task. Imagination, intellectual stamina, creativity and a huge courage is needed (Jacobsen, Clifford & Friesen, 2002).

According to Guskey (1986), many educational initiatives fail because of two factors; management fail to understand what motivates teachers to engage in professional development and the processes by which change in teachers typically occur. Trainings and professional development courses will only work if teachers can be shown evidence of improvement in their students’ learning outcomes, even more so in our exam-oriented community. This is the prerequisite if we want to see significant changes in the attitudes and beliefs amongst our teachers. Experienced teachers are seldom committed to new instructional approaches until they have seen it worked in their classrooms with their students (Guskey, 2002). Training and implementation that are combined with improved students’ learning will have more chances at incurring changes in attitudes and beliefs among teachers.

Change brings with it a certain amount of anxiety and threat. Why teachers are reluctant to change is because they are not sure if they can make the new practices work (Lortie, 1975). As change means risking failure, teachers do not easily alter or discard the practices that they have long developed and refined (Bolster, 1983). Technology intimidates even experienced teachers, as it makes them feel stupid, inept and at the mercy of situations where they do not understand and have no control. Change will not be implemented uniformly across schools as teaching and learning are influenced by a number of situational and contextual factors. Close collaboration between the system’s developer, and management will be of tremendous help in facilitating change among the teachers. Regular feedbacks on what they are doing, can sustain any little change they are trying to make.

Sustaining change after the implementation period must be seen as a continuous and ongoing endeavour. Considering the importance of their role, teachers’ perceptions of the newly implemented FROG VLE must be considered and taken into consideration for the betterment of the e-learning implementation in Malaysian schools. Though there are a number of studies carried out in other countries, effects of differences in context should not be discounted. Development of educational ICT path for every country is unique with its own educational, social, political and cultural contexts. These will differentiate factors that influence ICT usage among teachers according to the countries which they are from. So this study will be particularly useful in identifying factors that are affecting Malaysian teachers’ use of the e-learning.

3. Method

3.1 Participants
Participants in this study were 60 teachers from three secondary schools from two states in Malaysia. 18.33% of them mentioned no training was received so far while 75% indicated that they have received training with 6.67% did not indicate. 70% of them have less than fifteen years of teaching experience while the rest has more. As for the age of the respondents, 40% are male, one did not indicate, while the other 58.33% are female. As for their age mainly were in the 41 to 50 years old range (refer Table 1).

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>24-30</td>
<td>20%</td>
</tr>
<tr>
<td>31-40</td>
<td>23.34%</td>
</tr>
<tr>
<td>41-50</td>
<td>45%</td>
</tr>
<tr>
<td>51-60</td>
<td>11.66%</td>
</tr>
</tbody>
</table>

3.2 Procedures

Participants responded to an open-ended questionnaire administered to them in schools. An open-ended survey form with three questions that inquired about teachers’ perceptions of the benefits, barriers and suggestion for improvement towards the FROG VLE were distributed. Data were collected about six months after the FROG VLE’s was implemented across the nation.

3.3 Measures

Open-ended survey form was employed as the data collection method. Three questions posed were meant to provide a window on what was working or not working and what needed further refinement in the recent implementation of e-learning. The data collected were then analysed for key themes or patterns in teachers’ perceptions of the e-learning in schools. The data were analysed and results of the analyses were reviewed to verify for accuracy and enhance reliability. In our analysis process, we are aware of Van Maanen’s statement (1988), whereby, there can never be “immaculate perception”, and no text or research may be closed to further interpretations (Van Maanen, 1988). The study would provide different interpretations had it involved different researchers and participants and was carried out in another place or at a different time. With this realisation, the researchers have approached this research with the belief that there will not be any single one truth; instead there will be many, with multiple realities and multiple interpretations of the same events (Cohen et al., 2000).

4. Results

Several themes emerged from our analyses of the open-ended questionnaire. The findings were summarised and organised by the aforementioned three research questions.

4.1 Benefits of Teaching Online

4.1.1 For the students

Most teachers recognised that the FROG VLE has created lots of interest among the students. Besides interest, easy access to a wealth of materials and resources were some of the main benefits identified. These teaching and learning resources can help to improve learning outcome and increase self-directed learners among the students. Flexibility in learning regardless of place and time, increases motivation among the students and in the process it also increases their ICT usage and awareness of ICT’s potential as an alternative way to learning. This ‘updated’ approach of learning, in the long run provides greater opportunities when these students enter the job market. Respondents felt students will be more equipped with the much needed 21st century work skills. FROG VLE is more student-centered with its reduced need for teacher talk. However, despite the reduced in teacher talk, surprisingly a few teachers
felt that their interaction with their students can be increased through e-learning. Another important finding was when a number of teachers claimed that the system provides “hands-on” information for the students. These may be that with technology, students can view, listen, reflect and just do about anything in order to comprehend any new items that they wished to learn.

4.1.2 For the teachers

Many of the teachers appreciated FROG VLE in helping them make their teaching job easier than the traditional approach. Besides being easy to use, the system also helped them to organise their teaching and learning materials. This saves their time when updating or locating for specific materials. They are also pleased that with the system, they need not print or distribute handouts and this reduces cost substantially.

4.2 Barriers to Teaching Online

4.2.1 Within the School

Some teachers viewed lack of time as the key concern towards the e-learning implementation. They claimed the workload in school prevented them from exploring and mastering the system further. As such, many expressed critical need for more training and exposure of the system. Despite having trained, ICT skills remained an issue with the teachers. Not having technical support was also stressed as a main challenge in utilising the system, and teachers felt management should be working on this aspect to ease the innovation’s adoption process. Besides having limited ICT skills, lacking in English proficiency is also a barrier in understanding the FROG VLE. Some felt the language used was difficult for them to understand including the students. The inability to understand the language used by the system even caused confusion as claimed by some teachers. Validity of information over the internet was also questioned. Another identified barrier was having too many students in a class (30-40). This made it difficult for them to implement e-learning in the classroom. It is a challenge to let students take more responsibility for their own learning as they were not always on task. Whatever the technology being used, teachers with strong classroom management skills and ability to create a positive classroom culture are needed. Students tend to get distracted and visit other than the suggested websites, thus this lack of control was considered a struggle in running e-learning in the classrooms. One teacher also mentioned that she felt students were lazier when using the e-learning. Some felt teachers’ initial guidance is heavily needed by the students due to students lacking in skills and exposure in using the system. Nearly all teachers complained of poor internet connection and facilities as the greatest barrier towards e-learning implementation. Slow internet connection and that only certain areas in the school have access to the internet made it difficult for the teachers. They also claimed that they do not have enough working computers to make e-learning possible during their lessons. As such, due to the constraints expressed, plus high maintenance incurred by e-learning, some teachers insist preference over the traditional face-to-face approach.

4.2.2 Beyond the School

Teachers in their comments made it clear that not all students have access to internet and computers at home. These are the basic necessities that they felt the Malaysian government need to look into before exercising e-learning in our education system. To make matters worse, rural areas in Malaysia will need more time to make e-learning a reality. Students’ involvement beyond the classroom walls can only be turned into a reality when these barriers are removed.

4.3 Suggestions for Improvement

4.3.1 Training

Suggestions provided by most of the teachers reflected the urgent need for more training and assistance in delivering the e-learning. Technical support is necessary though very few teachers suggested this. Most of the teachers instead mentioned their lack of skills and confidence in utilising the FROG VLE.
They are of the opinion that with more skills and knowledge of the FROG VLE, they would be able to increase their usage. This should also be extended to trainee teachers at the Teacher Training Institute.

4.3.2 Facilities

A vast majority of teachers in the survey provided suggestions related to providing and upgrading the facilities in schools. Most teachers are crying out for better access to the internet, and ICT devices like laptop, both at school and at home. Internet access and computers for students at home must also be provided.

4.3.3 Awareness

Awareness programmes must be carried out to inform students, teachers and parents as to the e-learning initiatives. More enthusiastic involvement from students and soft pressure from the parents will hopefully create more urgency and motivate the teachers in sustaining the e-learning. Some respondents even suggested having a monthly e-learning programme, to make it more of a whole school initiative instead of individual teacher’s effort in the confine of his or her classroom.

4.3.4 FROG VLE’s Relevance

Subject like Mathematics was felt not compatible with the online system used. Innovative practices must be linked to school curriculum for sustainability. Teachers mentioned that they were not able to use certain symbols necessary in their teaching. A few teachers commented on the webpage design and content. The internet access to the e-learning is also restricting teachers’ usage or visits to certain websites, the Youtube for example. There were mixed opinions regarding this restriction as some agree to this while others felt this restriction was not necessary.

5 Discussions and Implications

The research described above sought to investigate the use of e-learning in the classrooms, as perceived by teachers, its benefits and barriers. They were also asked to provide some suggestions on how e-learning implementation can be sustained and improved. An open-ended survey was created which included three questions pertaining to the focus of this study. These findings are significant as they come directly from those who have the greatest power to provide an impact towards the success of the e-learning initiative. Findings suggest that e-learning has created lots of interest among students and could improve students’ learning outcomes as was also found in a number of previous studies (Vaughan, 2010; Callopy and Arnold, 2009). E-learning was also found to be helpful as it helped teachers in managing their materials and resources. Teachers also acknowledged that the use of e-learning provides opportunities for students beyond what they can offer in their traditional classrooms.

This study also provides important information as to the barriers in using e-learning. If e-learning is to be successful, teachers must have the appropriate technology, training and time to spend on the system. Trainings must not cease after the implementation, instead continued throughout the initial implementation when struggles are likely to be at their greatest. Moderate skill level and comfort in using the technology is a necessity. This is because their personal comfort and confidence will to a large extent depict how they approach the use of technology, design their lessons and approach the use of technology. Administrative support is also important especially by looking into facilities that are critically needed, like a reliable and fast internet connection plus to provide enough computers for all students. Administrators need to play a more active role in creating conditions in fostering the innovation. They must be the one who need to identify with the innovation, persuades and cajoles others into adopting the innovation. Their importance has many times been confirmed in many past empirical studies (Lafford, 2009; Young, 2008). Having access to internet at home is still not possible for many students. Involvement of parents was repeatedly stressed in order to overcome barriers. By educating parents as to the importance of e-learning, and if financial is not an issue, we would be able to see more students’ houses equipped with computers and internet access.
Analysis of findings on suggestions also showed heavy focus on the need for training and facilities for better uptake of the e-learning. Teachers realised the need for them to learn many new skills and unlearn instructional pedagogical practices that have long dominated their professional lives. To do this, teachers must be given ample time and support to master the FROG VLE. Learning to teach an online course requires time, preparing for online teaching involves considerable time, effort and workload. Kaleta, Skibba and Joosten (2007) in their study even proposed that teachers were to be given the necessary training at least six months before implementation. Creating a community of practice among the teachers may be a good idea as then teachers will not feel alone in their struggle. They will then have each other to bounce off ideas and make planning and preparation easier.

Carrying out this study has shown us a number of pertinent aspects about the e-learning implementation in Malaysian schools nationwide. The first most obvious was that most schools are not well-equipped. Poor internet connection and insufficient computers to cater for big number of students in each classroom made it quite a challenge for teachers to carry out online learning. Our second finding points towards the critical lack of training and support for teachers. There was a unanimous plea to provide teachers with the necessary ICT qualifications as to enable them to effectively engage students in using ICT to enhance their learning. Technological infrastructure and technical training are important aspects if e-learning success is to be expected. Finally, we also realised the lackadaisical attitude among the teachers, administrators and the relevant government agencies in trying to make this innovation a success. However, all is not lost as we also found some schools which were not involved in this study, but who are doing extremely well in their e-learning initiatives. Though their numbers are small, future studies need to study these schools in order to understand how barriers were removed in their contexts. Hopefully, they can act as catalyst of change for other schools to follow suit.

6 Conclusion

As mentioned by Einstein, “The only source of knowledge is experience”, teachers must start experimenting and experiencing with e-learning or Malaysian education system will be left far behind. This modest study was an attempt to explore teachers’ perceptions of the newly implemented online learning across the schools in Malaysia, in order to accelerate the usage of e-learning across schools nationwide. Lacking in facilities and training were found to be the most common barrier among educators. As such, increasing the sense of urgency to use technology must be accompanied with reliable and effective on-going support by providing what teachers need. Knowing the benefits of e-learning alone will not help accelerate the adoption process if teachers do not have sufficient pedagogical and technological knowledge and skills. Room to experiment, to make mistakes, to try again and finally learn must be made part of the school culture if change is expected.

References


Unpacking the Researcher-Teacher Co-Design Process of a Seamless Language Learning Environment with the TPACK Framework

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Abstract: Integrating InfoComm Technology (ICT) into teaching and learning poses challenges for teachers, such as the lack of know-how, self-efficacy and time to design interventions. A possible solution is the design of sound Technology-Enhanced Learning (TEL) environments with relevant content and pedagogical tools to reduce teachers’ design efforts. Technological pedagogical content knowledge (TPACK) could be used as a framework for understanding how teachers could integrate ICT into classrooms. Originally developed for informing teacher development, recent scholars called for ‘repurposing’ the framework to guide the design of TEL that encapsulate holistic TPACK knowledge. We therefore employed TPACK to design the TEL environment of ‘MyCLOUD’ to advance the use of mobile and cloud technologies for seamless Chinese Language learning. In this paper, we unpack how the distributed TPACK resources has contributed to the design of MyCLOUD. The analysis is accomplished through our coding and consolidation of 42 researcher-teacher meeting minutes throughout the developmental period where rounds of design-implementation-reflection-redesign process were jointly carried out by the participants. This is followed by a study of students’ perceived usability of the platform. This study therefore demonstrates how the development of TEL can be attained by leveraging TPACK as a basis of technical design.

Keywords: Seamless Language Learning; Technological Pedagogical Content Knowledge (TPACK); Design analysis; Design-based Research; User Acceptance Test

1. Introduction

Integrating InfoComm Technology (ICT) into teaching and learning poses huge challenges for teachers, such as the lack of know-how, self-efficacy and time to design useful interventions (e.g., Laferrière, Hamel, & Searson, 2013). A possible solution is the design of sound Technology-Enhanced Learning (TEL) environments to reduce their design efforts. Well-designed TEL environments with relevant content and pedagogical tools in place would reduce the cognitive load and help shape and elevate their competencies in enacting ICT-mediated pedagogies.

Technological pedagogical content knowledge (TPACK) could be used as a guiding framework for understanding how teachers could integrate ICT into actual classrooms (Mishra & Koehler, 2006). The TPACK framework argues that effective technology integration for teaching specific content or subject matter requires understanding and negotiating the relationships between these three components: Technology, Pedagogy and Content. Many studies have adopted this framework to design teachers’ professional development (TPD) activities, which have supported its efficacy for enhancing teacher competencies. Recent scholars (Chai, Koh, & Tsai, 2013) called for ‘repurposing’ the framework for informing the design of TEL environments that encapsulate holistic TPACK knowledge. To date, however, there has been only one such environment designed for the learning of software development by computer engineering undergraduates (Wu, Chen, Wang, & Su, 2008).

We therefore employed the TPACK framework to design a TEL environment to advance ICT integration for self-directed, collaborative and seamless Chinese learning. Code-named MyCLOUD (My Chinese Language ubiquitOUs learning Days), the design-based research (DBR) project is intended to develop a new mobile- and cloud computing-assisted language learning practice that encompasses multiple learning spaces. The iterative development of the MyCLOUD 1.0 learning environment, which
is comprised of a technological platform, classroom pedagogy and learning materials, took place from September 2010 to November 2012. It involved the participation of university researchers and primary school Chinese teachers in Singapore.

In this paper, we unpack how the various knowledge resources had contributed to the design of the TEL environment. The retrospective analysis is accomplished through our coding and consolidation of meeting minutes throughout the developmental period where rounds of design-enactment-reflection-redesign process were jointly carried out by the researchers and the teachers. This is followed by a study of students’ perceived usability of the platform. This research therefore contributes to current development of TEL, which may be overly technology-centric, by using TPACK as a basis of system design. We argue that TPACK is essential in enhancing the ecological validity of the TEL environments.

2. Literature Review

2.1 TPACK

The TPACK framework specifies three forms of knowledge: technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK), which are all needed in order to integrate ICT into classrooms. When these three forms of knowledge interact, technological pedagogical knowledge (TPK), technological content knowledge (TCK), pedagogical content knowledge (PCK) and technological pedagogical content knowledge (TPACK) are formed. TPK are knowledge about how to use different technologies in a pedagogically sound manner; TCK are forms of content representations that ICT can provide for specific form of CK, and PCK are the knowledge teachers possess to help bridge students’ understanding of CK. TPACK are the syntheses of all aforementioned forms of knowledge for ICT integrated lessons (Cox & Graham, 2009). Teachers need to acquire or create such knowledge for sound integration to happen. Learning technologists can also draw from the research in TPACK when they develop technology to enhance learning. We therefore review relevant aspects of knowledge, including language learning (CK/PCK-related), seamless learning (PK/TPK-related), and the notion of ‘learning hub’ (TK/TCK-related). This is to path the way for the creation of the MyCLOUD environment.

2.2 The CK/PCK related consideration: Chinese language learning

Classroom practice inevitably shapes learners’ language learning practice and impact upon their language competencies. Contemporary language learning researchers (e.g., Liu, Goh, & Zhang, 2006; Tedick & Walker, 2009) have argued that that conventional language classrooms typically fall short in the following aspects: (1) They are overly teacher and knowledge centric (2) De-contextualized; (3) Predominantly “presentation-practice-production” (PPP model); and (4) Disconnections between skills and knowledge,. Traditional language classrooms fail to practice autonomous learning by the learners and authentic social interactions beyond the classroom. Such practices are not conducive in developing learners’ communicative skills and elevating/sustaining their learning motivation (Liu et al., 2006; Wong, Chai, & Aw, in-press).

The above shortfalls prompted the emergence of sociocultural and communicative approaches towards language learning (Lightbown & Spada, 2013), which view language learning as an active process where learners make meaning through activities that reflect real-world contexts (Widdowson, 2003). Social interaction is the context where language use and language learning co-occur (Min, 2006). Participation in social interactions is the goal and the means for language learning. These imply that language learning needs to depart from transmissionism and promote authentic and social learning.

2.3 The PK/TPK related demands of 21st century—seamless learning

Seamless learning is one of the advanced learning approaches that can potentially address the needs of 21st century learners in dealing with the challenges posed by the era of exponential changes. Chan et al. (2006) advocate that the key of seamless learning is in leveraging 1:1 (one-or-more-device-per-student) setting to facilitate anytime anywhere learning. This fosters among learners the bridging of learning efforts across a variety of settings (e.g. formal/ informal learning, individual/social learning, and learning in physical/digital realms). Seamless learning has evolved from a technology- enabled mobile and
ubiquitous learning approach (e.g., Hwang, Tsai, & Yang, 2008) to a constructivist curriculum design or knowledge creation approach (Looi & Wong, 2013); and moved beyond situated learning where learning is no longer confined within a single ‘situation’ but reference to a learning culture (Milrad et al., 2013). Seamless learning pedagogy should therefore focus on long-term fostering of learners’ disposition and skills in carrying out seamless learning, thus resulting in the emergence of a new learning community.

2.4 The TK/TCK related consideration: ‘Learning Hub’ with tools

‘Learning Hub’ is a notion arisen from earlier research in seamless learning (Zhang et al., 2010). The mobile device carried by a learner on a 24x7 basis could integrates all the personal learning tools, resources and self-created artifacts at one place, thus serving as a learning hub. The learning hub can facilitate a learner in managing her/his own seamless learning journey. Suitable learning resources that the learner acquires along her/his ongoing learning journey to mediate the latest learning task could be stored, used and modified conveniently (Wong & Looi, 2011). Simply put, a ‘learning hub’ should be the nucleus of: (1) a suite of tools to support learning activities, and (2) the medium to document the learner artifacts. In addition, Wong (2012) argued that the fast-rising cloud computing technology offers personal ‘learning hub’ that need not be associated with any device. Instead, it may exist as a learner account that stores the learner’s history on a cloud-based platform with a suite of learning tools.

The above review sums up current issues of language learning (CK/PCK) which mobile-related technologies complemented by cloud computing (TK/TCK) could be designed to support socio-centric constructivist pedagogy (PK/TPK). These considerations formed the grounds for MyCLOUD.

3. Research Context

MyCLOUD is a DBR study with the aim of developing a seamless Chinese Language learning environment for Singapore primary school students with Chinese as second language standard. The key idea is to facilitate a long-term seamless language learning practice that is blended into the formal curriculum to foster a cross-space ongoing learning process among the learners. The conceptualization and development of the MyCLOUD environment began in September 2010, which was subsequently piloted in three Primary 3 classes in the experimental school between August 2011 and November 2012.

We adopted DBR as the methodology, which considers the subject of study to be a complex system involving emergent properties that arise from the interaction of more variables than are initially known to researchers (Brown, 1992). Therefore, design-based researchers attempt to optimize the design in real-life settings and to observe how different variables and design elements interact (Barab & Squire, 2004). Hence, the design-enactment-reflection-refinement cycles are iteratively conducted with conjectures created and perhaps refuted, and new conjectures are developed in the next cycle and tested.

This paper reports the first DBR cycle of the MyCLOUD project from September 2010 to November 2012. During the cycle, the university researchers and 4 Chinese teachers formed a taskforce to progressively co-design, enact and refine the learning environment. The platform development was outsourced to a commercial software developer. The DBR cycle consisted of 2 phases:

- Phase 1: Learning environment conceptualization and design (Sep 2010–Jun 2011). The taskforce met fortnightly to co-design the learning environment, with frequent participation from the software developer. Phase 1 ended with the launch of MyCLOUD 1.0 in July 2011.
- Phase 2: Curriculum piloting and pedagogy refinement (Jul 2011–Nov 2012). The 16-month pilot study in three Primary 3 classes commenced and the fortnightly taskforce meetings continued. The researchers observed and analyzed the curriculum enactment and the students’ learning progress for reflection and tweaking of the learning environment design.

In this paper, we unpack our reasoning and articulate the knowledge resources we work on to holistically design the MyCLOUD 1.0 learning environment as guided by the TPACK framework. This is followed by a study of students’ perceived usability of the platform. This paper is therefore positioned as a design synthesis paper or design analysis paper on the learning environment; while the detailed analysis of student learning processes and outcomes are reported elsewhere (Aw, Quek, Wong, Zhang, & Li, in-press). The research questions that guide the writing of this paper are,

- RQ1. How did the taskforce collectively create and improve MyCLOUD 1.0?
- RQ2. What were the students’ perceptions of usability, ease-of-use and acceptance of MyCLOUD 1.0?
To address RQ1, we qualitatively analyzed 42 written minutes of taskforce meetings to distil the important design decisions that led to the creation of MyCLOUD 1.0. Two researchers coded the documents independently in terms of TPACK-related decisions made (with Table 1 as the coding scheme). The coding traced the 7 categories of TPACK that were discussed during the meetings and the new forms of TPACK co-created by classifying them according to the categories. The two coders then compared the coded documents and discussed discrepancies (about 15% of the codes) until consensuses were reached. Adapted from the analytical scheme presented in Wu et al. (2008), the qualitative outcomes of the analysis is then consolidated in a two-dimensional matrix for each phase: 7 categories from TPACK versus 3 categories (new design ideas, emergent challenges and solutions).

Table 1: Coding Scheme of TPACK decisions.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technological Knowledge (TK)</td>
<td>How to use the functions of mobile devices and MyCLOUD platform.</td>
</tr>
<tr>
<td>Pedagogical Knowledge (PK)</td>
<td>How to facilitate language learning through pedagogical strategies such as seamless learning.</td>
</tr>
<tr>
<td>Content Knowledge (CK)</td>
<td>How to use domain-specific content knowledge such as orthographic (word structure), phonic (pronunciation) and functional knowledge of Chinese language.</td>
</tr>
<tr>
<td>Pedagogical Content Knowledge (PCK)</td>
<td>How to enhance students’ vocabulary knowledge through contextualized writing activities.</td>
</tr>
<tr>
<td>Technological Pedagogical Knowledge (TPK)</td>
<td>How to facilitate socio-constructivist learning through the social networking feature in the MyCLOUD platform.</td>
</tr>
<tr>
<td>Technological Content Knowledge (TCK)</td>
<td>How to construct linguistic knowledge through the use of Mictionary and other online dictionaries.</td>
</tr>
<tr>
<td>Technological Pedagogical</td>
<td>How to carry out an ongoing, contextualized and collaborative language learning process by applying the MyCLOUD learning model.</td>
</tr>
<tr>
<td>Content Knowledge (TPACK)</td>
<td></td>
</tr>
</tbody>
</table>

To answer RQ2, we administered a questionnaire to 259 students from the entire Primary 3 level in the experimental school who were enrolled in the scaled-up MyCLOUD curriculum in 2013. We adapted the survey instrument developed by Chen and Huang (2010), which is comprised of three factors: perceived usefulness, perceived easy to use, and system acceptance. The items were reviewed by the teachers before administering to ensure language suitability.

4. Design Synthesis

4.1 Phase 1 (learning environment conceptualization and design) (Sep 2010 – Jun 2011)

The phase began in September 2010 with the teachers informing the researchers on existing Primary 3-4 curriculum, their classroom practices, and students’ learning difficulties, i.e., the design considered teachers’ CK, PK and PCK as essential inputs. The teachers acknowledged that they were practicing the PPP model; while the students’ common learning difficulties include the lack of self-efficacy in learning the language and applying it in daily life due to limited vocabularies, English-style grammar, etc. An agreement was reached that MyCLOUD is not (merely) meant for enhancing the existing pedagogy. The intention was to foster a new language learning practice informed by the sociocultural perspective of SLA by leveraging all opportunities of language learning, applications and reflections within and beyond the class hours. The taskforce then spent 10 months to co-design and prototype the TEL environment, with the involvement of a software vendor in the aspect of ICT development. As the university could not support the development, the taskforce outsourced the technological development work. The limitation of such an approach was revealed in Phase 2 (see later). Tables 2 summarizes our qualitative analysis on the most important decisions made during the meetings held within Phase 1.

Informed by the notion of seamless learning, the SLA theories and the research team’s previous study (Wong, Chin, Tan, & Liu, 2010), the researchers sketched a design framework which were then discussed within the taskforce. Teachers’ comments were received and the framework was adapted (Figure 1). The framework can be seen as the initial TPACK designed by the taskforce, comprising of the intertwining dimensions of seamless and language learning. Within the seamless learning dimension, the Facilitated Seamless Learning (FSL) framework (Wong, 2013) is adopted as the basic learning process to guide the actual learning activities. FSL is represented as a cyclic, non-linear process that consists of the following four activity types (CK1-1, PK1-1, PCK1-1 in Table 2):

1. **In-class learning engagement:** These are teacher-facilitated activities in formal settings, to get students to begin the learning of new vocabularies and prepare them for activities (2) and (3).
Table 2: TPACK-informed analysis on the major decisions made in Phase 1

<table>
<thead>
<tr>
<th>ID</th>
<th>New design concept</th>
<th>Challenge</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>CK1-1</td>
<td>Deep learning of Chinese vocabularies not only in their meanings and pronunciations but also the ability of applying them in appropriate contexts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PK1-1</td>
<td>Learning Chinese through self-directed, contextualized language applications and social interactions. The learning design is student-centric and the pedagogy is meant for nurturing such a habit-of-mind among the students.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TK1-1</td>
<td>Employ mobile &amp; cloud technologies to develop MyCLOUD.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCK1-1</td>
<td>Tap on student artifacts in in-class consolidation activities for students to carry out peer reviews.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCK1-1</td>
<td>Tap on online resources, e.g., e-dictionary &amp; voice synthesis, to support content learning.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCK1-2</td>
<td>Develop Mictionary functions that afford students to self-manage vocabulary learning.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPK1-1</td>
<td>Build personalized space (Mictionary) and social space (MyCLOUDNet) to reduce student perception on MyCLOUD as a formal learning environment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPK1-2</td>
<td>Adopt duo-platform model: MyCLOUD app for just-in-time learning tasks (e.g., artifact creation and social interactions) that is blended into daily life; and web version accessible from home computer for more complex tasks.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPK1-3</td>
<td>Build simple learning analytics on students’ activeness, e.g., to display number of new vocabularies added to Mictionary, number of artifacts created, etc., over a period of time.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPK1-4</td>
<td>Implement classroom management module where teachers may enable or disable certain sets of tools on student devices at different time. This is to prevent or reduce the 1:1 classroom management issue where students might misuse the devices during lessons.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPACK1-1</td>
<td>The platform should facilitate easy, semi-automated bridging of multiple learning spaces: formal (MyTextbook) and informal (Mictionary) spaces, individual (Mictionary) and social (MyCLOUDNet) spaces, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPACK1-2</td>
<td>An existing classroom practice is that the teachers instruct the students to highlight unfamiliar words on the textbook. The “My Textbook” component of MyCLOUD should provide a similar affordance – students use the mouse to highlight salient vocabularies, right click to add them to Mictionary.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. The learning design framework of MyCLOUD.

(2) **Personalized contextual learning**: Individual learners proactively observe, record, and reflect upon their daily encounters and apply their knowledge in their daily life. In MyCLOUD, the activities constitute of taking photos and making sentences pertaining to their daily encounters and posting such student artifacts onto MyCLOUD as social media.

(3) **Online peer learning**: In the online social space, learners carry out peer discussions mediated by their prior knowledge, resources, reflections and learner artifacts created during (1) and (2).

(4) **In-class consolidation**: Teachers facilitate and scaffold learners in in-class discussion and consolidation on teacher-supplied or learner-created artifacts during the entire FSL cycle. Meanwhile, as depicted in the upper layer of language learning dimension, students individually create the digital language artifacts in the forms of sentences or paragraphs with or without photos to be uploaded. In the community, these artifacts are shared, reviewed and revised for deeper learning.

Informed by the framework, the taskforce and the software vendor proceeded to co-design MyCLOUD with the following main modules,
• **Mictionary**: Mictionary refers to ‘Mobile dictionary’. In Mictionary, students record the vocabularies that they encounter in and out of class, and perform searches for meanings and exemplary uses. It serves as their personalized vocabulary learning e-portfolio where they are required to build most of the content on their own, such as adding the photo-sentence artifacts that utilize the vocabulary on the ‘vocabulary page’ or pooling relevant online resources (TCK1-2).

• **My e-Textbook**: The digitized textbook passages are linked to a web-based text-to-speech service powered by Microsoft Bing for the platform to read them aloud. Students can highlight unfamiliar vocabularies and this will add the vocabularies to Mictionary (TCK1-1, TPACK1-2).

• **MyCLOUDNet**: This is a social networking space for students to tweet or carry out photo-blogging (photo(s) + sentence(s), i.e., ‘student artifacts’), and respond to others’ artifacts. Students may (1) perform peer reviews to improve the accuracy and complexity (linguistically or contextually) of individual artifacts; or (2) be engaged in social interactions. Both types of responses are collectively known as ‘replies’ hereafter (TPK1-1).

• **My Teaching Pal**: This is the classroom management module for the teachers to create lesson packages prior to the class, and manage the learning flow and enable all or selectively limit students’ accesses to the features on MyCLOUD platform during the class. (TPK1-4)

In essence, My e-Textbook belongs to the formal learning space while MyCLOUDNet is an informal space. Mictionary bridges the two spaces by linking to My e-Textbook and MyCLOUDNet. If a student creates an artifact and add it to a vocabulary page in Mictionary (individual, formal-informal bridging space), the artifact will also be automatically duplicated to MyCLOUDNet (social, informal space). Two types of peer discussions could emerge – corrective/enriching feedback or social interactions on individual artifacts in MyCLOUDNet. Such discussions can be characterized as social meaning making which may trigger individual learners’ reflections (TPK1-1, TPACK1-1).

The ICT architecture that we adopted to implement the MyCLOUD platform is the cloud-mobile model according to the revised ‘learning hub’ notion according to Wong (2012) (TK1-1). The platform is accessible by both a web-based interface and a mobile app. The former offers the full set of features while the latter provides a sub-set of functions for students to carry out quick learning tasks, such as creating student artifacts, online interactions and referencing to Mictionary, in their daily life.

In addition, we incorporated simple learning analytics features into the system, accessible by both the teachers and the students, such as reporting the frequencies of online activities of individual students and the whole class (e.g., new vocabularies added to Mictionary, artifact creations, online interactions, number of times each vocabulary is utilized by a student, etc.). This helped teachers to monitor student participation and adapt their interventions where necessary (TPK1-3).

The first working prototype of the MyCLOUD platform was implemented by the software vendor (see Figure 2 for the screen captures in the web version). Subsequently, a usability test was conducted by involving a group of Primary 3 students to use the tools and offer comments. The platform was then refined accordingly. The system was ready for deployment by July 2013.

![Screen captures of the main components on the MyCLOUD platform (web version)]
4.2 Phase 2 (curriculum piloting and pedagogy refinement) (Aug 2011 – Nov 2012)

MyCLOUD 1.0 was launched in July 2011. 84 students in three Primary 3 classes were then involved in a 16-month school-based pilot study. Each of the students was assigned an Acer Iconia Tab W501 tablet for 24x7 access. Similar to Table 2, the major decisions made during Phase 2 is summarized in Table 3. There was a major shift of focus in the taskforce’s design efforts – from conceptualizing a new intervention and transforming it to a learning environment in Phase 1 (i.e., more “Major design concepts” in Table 2), to developing concrete lesson plans and tackling the challenges emerged during the pilot study in Phase 2 (i.e., more “Emergent challenges” raised and addressed in Table 3).

Phase 2 was focused on the co-design of a basic lesson structure to guide future lesson designs (see TPACK2-1 in Table 3). Nevertheless, the taskforce agreed that highly structured lesson plans may not be aligned with the spirit of constructivism and seamless learning. Instead, teachers and students should be encouraged to exercise flexibility. Consequently, the three teachers in the pilot study referenced the basic lesson plan structure, co-designed overarching learning activities for the chosen lesson units to be taught through MyCLOUD, and then individually adapted them to suit the profile and the progress of the students in their respective classes (i.e., ‘differentiated learning’).

Table 3: TPACK-informed analysis on the major decisions made in Phase 2

<table>
<thead>
<tr>
<th>ID</th>
<th>New design concept</th>
<th>Emergent challenge</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>PK2-1</td>
<td>How could we assess students' performance as they may not complete their assigned work?</td>
<td>Students had been making superficial comments and corrections on peer artifacts on MyCLOUDNet.</td>
<td>Teachers strike a balance between student autonomy and teacher-directed activities. Moderately instill discipline as the students are very young. Enact formative assessment.</td>
</tr>
<tr>
<td>PK2-2</td>
<td>Students' early emphasis on teaching new nouns that relatively lack contextual diversity in their usage were one of the reasons for students’ creation of ‘dull’ artifacts.</td>
<td>Teachers strike a balance between student autonomy and teacher-directed activities. Moderately instill discipline as the students are very young. Enact formative assessment.</td>
<td></td>
</tr>
<tr>
<td>PCK2-1</td>
<td>Teachers’ early emphasis on teaching new nouns that relatively lack contextual diversity in their usage were one of the reasons for students’ creation of ‘dull’ artifacts.</td>
<td>Ensure greater form diversity in the choice of vocabularies to learn, i.e., nouns, verbs, adjectives, adverbs, conjunctions and idioms, etc. This may trigger students’ creation of more contextually rich artifacts.</td>
<td></td>
</tr>
<tr>
<td>TPK2-1</td>
<td>Students should be able to revise their artifacts posted on MyCLOUDNet after peer feedback. The edit function was not available on MyCLOUD 1.0.</td>
<td>Allow students to use English sparingly for replies in the first 1-2 months but artifact creation must be in Chinese. Inform them upfront that after the grace period, they should use pure Chinese for online activities.</td>
<td></td>
</tr>
<tr>
<td>TPK2-2</td>
<td>Many students find difficulties in expressing in Chinese or inputting Chinese text in the beginning, thus unmotivated to participate in the online activities.</td>
<td>Many students find difficulties in expressing in Chinese or inputting Chinese text in the beginning, thus unmotivated to participate in the online activities.</td>
<td></td>
</tr>
<tr>
<td>TPK2-3</td>
<td>Students may add vocabularies incidentally used in their artifacts posted on MyCLOUDNet to Mictionary.</td>
<td>Students may add vocabularies incidentally used in their artifacts posted on MyCLOUDNet to Mictionary.</td>
<td></td>
</tr>
<tr>
<td>TPK2-4</td>
<td>Design &amp; enact mobile learning trails at Haw Par Villa and Asian Civilisations Museum to facilitate collaborative and authentic language learning.</td>
<td>Design &amp; enact mobile learning trails at Haw Par Villa and Asian Civilisations Museum to facilitate collaborative and authentic language learning.</td>
<td></td>
</tr>
<tr>
<td>TPK2-5</td>
<td>Some students face difficulties in making sentences with newly-learned vocabularies at classroom lessons.</td>
<td>Some students face difficulties in making sentences with newly-learned vocabularies at classroom lessons.</td>
<td></td>
</tr>
<tr>
<td>TPK2-6</td>
<td>Teachers co-design the following learning process where students work in groups to (1) search online dictionary for the vocabulary; (2) pick a sample sentence using the vocabulary; (3) search for a photo depicting the sentence; (4) modify the sentence by referencing to other elements in the photo.</td>
<td>Teachers co-design the following learning process where students work in groups to (1) search online dictionary for the vocabulary; (2) pick a sample sentence using the vocabulary; (3) search for a photo depicting the sentence; (4) modify the sentence by referencing to other elements in the photo.</td>
<td></td>
</tr>
</tbody>
</table>
Apart from classroom lessons, the taskforce also co-designed and integrated activities to reinforce students’ authentic learning in daily life, i.e., to nurture their habit-of-mind in seamless learning. Two designs for these purposes are (1) Learning processes that encompass the full FSL cycle and tap on Chinese New Year and school vacation (\textit{TPACK2-3}); (2) Out-of-school mobile learning trails to facilitate collaborative and contextualized language learning and applications (\textit{TPACK2-4}).

Given the nature of DBR, ongoing refinements of the learning environment as triggered by emergent implementation challenges are inevitable. Thus, rapid (re-)prototyping of the platform was desired. However, the funding cycle prevented ongoing fine-tuning of MyCLOUD. This gave rise to the strategy as stated by a researcher, “\textit{(In seeking for solutions to the emergent challenges,) we can hold TK as a constant for the time being, and seek for tweaking PK and CK variables.”} Table 4 consolidates the proposed important enhancements on the forthcoming MyCLOUD 2.0 learning environment (in the 2nd DBR cycle) which emerged from the taskforce’s tackling of challenges in Phase 2. The reporting of the 2nd DBR cycle is out of the scope of this paper as it has only started a few months before this paper is finalized (after we secured new development funding), with the MyCLOUD 2.0 platform still at its preliminary system design stage. We will report the implementation of and evaluation of the proposed enhancements in a future publication.

### Table 4: Proposed enhancements in 2nd DBR cycle and MyCLOUD 2.0 platform

<table>
<thead>
<tr>
<th>Pedagogical/learning Design</th>
<th>Technological Upgrades</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PCK3-1</strong> Develop systematic strategies to nurture students’ habit-of-mind and skills in creating quality artifacts and being engaged in meaningful social interactions and peer reviews.</td>
<td><strong>TCK3-1</strong> Advanced learning analytics to perform corpus analysis, social network analysis, etc. (To pick up what was left out in TPK1-3)</td>
</tr>
<tr>
<td><strong>TPK3-1</strong> Derive effective principles or guidelines for teachers’ presence in MyCLOUDNet communities, without overloading teachers. During the pilot study, teachers’ involvement in student discussions were relatively ad-hoc.</td>
<td><strong>TPK3-2</strong> Insert a field under each student artifact on MyCLOUDNet to encourage the author to improve the text after peer discussion (not directly edit the original text) so that both versions of text are displayed to make the improvements explicit to all students. This is for facilitation of process-oriented writing (a TPK solution to TPK2-1)</td>
</tr>
<tr>
<td><strong>TPACK3-1</strong> Employ flipped classroom-like strategy by asking students to learn and even apply certain vocabularies (e.g., to create artifacts) before the lesson. The artifacts could then be discussed in the classroom.</td>
<td><strong>TPK3-3</strong> Implement ‘like’ and ‘badge’ functions on the platform to boost student participation. (a TPK solution to PK2-1)</td>
</tr>
</tbody>
</table>

### 5. User Evaluation

Throughout the study, the university researchers had been collecting various forms of data to continually evaluate the designed learning platform. The findings in students’ learning processes and outcomes, and the participating teachers’ development and perceptions on the learning environment are reported elsewhere (Aw et al., in-press; Wong, Chai, Aw, & King, in-press). In line with the aims of this paper, the results of the user acceptance survey are reported. As stated before, the 20-item, 5-point Likert-scale survey instrument developed by (Chen & Huang, 2010) was adopted and customized to the context of the MyCLOUD environment. The survey examines students’ perception of usefulness (PU), perceived ease-of-use (PEU) and user acceptance (UA). The survey was administered to 259 students in the beginning of the 2nd DBR cycle. To test the construct validity of the survey, confirmatory factor analysis (CFA) was conducted. After removing 3 items with low factor loadings, CFA yielded satisfactory model fit indices ($\chi^2=250.57$, $\chi^2/df=2.16$, $p<0.001$, RMSEA = 0.067, CFI = 0.95, GFI=0.90) (Hair, Black, Babin, Anderson, & Tatham, 2010). Average variance extracted (AVE) and the composite reliability (CR) were computed to further examine the instrument and the results indicate that the instrument is valid and reliable. Table 5 below provides the means, standard deviation and factor loading, AVE and CR. The findings from the usability tests indicates that the primary 3 students perceive the MyCLOUD 1.0 environment as acceptable (UA=3.82), easy to use (PEU=3.92) and useful (PU=3.74), since all ratings are above the mid-point of 3. The general efficacy of the platform is thus supported.

### 6. Discussion and Conclusion

In this study, we developed and evaluated MyCLOUD, a learning environment for Primary school students’ seamless Chinese Language learning. The researcher-teacher taskforce designed specific modules of applications that utilize technological affordances to support pedagogical strategies for seamless Chinese Language learning, based on their understanding of the students’ current learning practices and shortcomings. Specifically, the taskforce drew upon their collective TPACK knowledge to
build the learning environment. Such a holistic consideration of learning environment design was well-manifested in a comment made by a researcher during a meeting (24 December 2010), “We need to be wary whether this suite of applications will actually complement or distract students’ learning. Although it may appear to be useful to have multiple tools on an integrated platform, the crux is what should be put inside. What we should introduce is a platform, not just a string of tools.”

Table 5: Mean, SD, Factor loadings, AVE and CR of the user acceptance test (n=259)

<table>
<thead>
<tr>
<th>Items</th>
<th>Mean</th>
<th>SD</th>
<th>Factor loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: Perceived Usefulness (PU), AVE =0.59, CR =0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU1 MyCLOUD is helpful to my learning.</td>
<td>3.74</td>
<td>0.99</td>
<td>0.84</td>
</tr>
<tr>
<td>PU2 It’s more efficient for me to learn Chinese in MyCLOUD.</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU3 MyCLOUD can help me better understand Chinese vocabulary.</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU4 The smartphone with MyCLOUD is good for learning.</td>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU5 With MyCLOUD, I use Chinese more often than before.</td>
<td>0.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU6 I learn good Chinese sentences and compositions from my classmates on MyCLOUD.</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU8 I will continue to use MyCLOUD in Chinese learning in the future.</td>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2: Perceived Ease of Use (PEU), AVE =0.52, CR =0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEU1 MyCLOUD platform is easy to use.</td>
<td>3.92</td>
<td>0.95</td>
<td>0.77</td>
</tr>
<tr>
<td>PEU2 MyCLOUD is a convenient platform for me to interact with my classmates.</td>
<td>0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEU3 It is easy to upload pictures to MyCLOUD platform.</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEU4 It is easy to type in Chinese in MyCLOUD using smartphone.</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEU5 I find it easy to do what I want to do in MyCLOUD, such as commenting on others’ sentences.</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3: User Acceptance (UA), AVE =0.52, CR =0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UA1 Learning Chinese using MyCLOUD is enjoyable.</td>
<td>3.82</td>
<td>0.94</td>
<td>0.63</td>
</tr>
<tr>
<td>UA2 I like to make sentences in MyCLOUD.</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UA3 I like to interact with classmates in MyCLOUD.</td>
<td>0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UA4 I like to post and share my interesting things in daily life in MyCLOUD.</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UA5 I enjoy reading the teachers’ and peers’ online comments for my work.</td>
<td>0.83</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Indeed, in the TEL field, many existing learning platforms were developed by pooling a variety of features without clear pedagogical considerations or design of learning flow to optimize the use of these functionalities. In designing MyCLOUD, we instead derived and mapped a variety of seamless language learning activities into the FSL framework to assist the students in establishing a coherent cross-space learning flow and experience. The three student-accessible modules of the platform were then designed to support the learning flow, particularly the bridging of formal (My e-Textbook) and informal (MyCLOUDNet) learning spaces (through Mictionary as the bridging module), individual (Mictionary) and social (MyCLOUDNet) learning spaces, and, learning amidst the interplay of physical and digital spaces during classroom lessons (using all three modules) and artifact creation tasks in authentic real-life settings (and subsequently posting on MyCLOUDNet and Mictionary).

Based on our qualitative analysis on the two-phased design process, whereas the entire design process was essentially underpinned by the researchers’ TPK (by proposing the notion of mobile- and cloud-mediated seamless learning and sociocultural perspective of language learning to frame the design), the teachers’ PCK that they established over the years of practice (students’ learning preferences and difficulties, classroom dynamics and resource limitations, etc.) had been playing a crucial role in creating conducive conditions for a scalable and sustainable practice. Therefore, the eventual learning environment by the end of Phase 2 is a manifestation of newly created TPACK.

Thus, this paper contributes to the TEL literature not only in term of explicating the development of an innovative seamless language learning environment. It has demonstrated how the TPACK framework can be employed to guide the design of a holistic TEL environment that leverage distributed TPACK knowledge of researchers, practitioners and software developers. Through the collective design effort of the taskforce, an easy-to-use and useful platform that is well accepted by the 3rd graders was created. In terms of learning outcomes, we have also obtained some positive findings (Aw et al., in-press). Given these results, we would recommend TPACK as a common framework for researchers, teachers and software developers for the co-design of TEL environments. It is vital for TEL environments to be designed in consideration of pedagogy and content matters so that the system will possess higher ecological validity and therefore be useful in practice.
References


A2I: A Model for Teacher Training in Constructive Alignment for Use of ICT in Engineering Education

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Abstract: The outcome-based approach of education requires engineering faculty to be able to align the student learning objectives with their instructional and assessment strategies. With the increasing use of educational technology, faculty technology integration also becomes an essential part of this alignment. Though there exist instances of training programmes that help faculty to achieve this alignment and integration, there are no validated frameworks or models that will enable teacher educators to prepare good instructional development programmes for the faculty. Attain-Align-Integrate (A2I) is a model for teacher educators to create short-term training programmes (STTP) to achieve constructive alignment in use of Information and Communication Technology. In this paper we describe the model, its key features, then the instantiation of the model as a STTP. Following this, the evaluation of the STTP is described to explain the utility of the model for attaining faculty professional development goals. The results of STTP indicate that participants have shifted from a teacher-centric instructional strategy to a student-centered one, however they require more practice in the alignment to integrate it completely within their teaching learning environment.

Keywords: Teacher Training Model, Constructive Alignment, Technology Integration, Short Term Training Program, Engineering Education

1. Introduction

The engineering education system in India is affected with issues of decline in student as well as teacher quality (Bloom and Saeki, 2012). There exist numerous examples of teacher training programmes across the world, tailored in content and implementation (Dettori & Forcheri, 2003), to address the performance gap. Due to the wide differences in the operating contexts of these programs, their implementation designs are not suitable for direct adaptations. Thus there is a need for a validated framework or model for short-term teacher training program designs (Felder et.al., 2011). The proposed Attain-Align-Integrate (A2I) teacher-training model has been developed to address this problem. The major goals of this paper are: (a) To describe this model for designing short-term teacher training programme (STTP) that combines student-centered approaches with instructional alignment, and (b) Evaluate the STTP that emerged out the model for the learning and change in perception of faculty.

The A2I model consists of 3 phases - Attain, Align and Integrate, aimed at improving the knowledge of faculty in combining instructional alignment with student constructivist approaches, or constructive alignment (Biggs, 1996), within their course. The model prescribes creation of activity slices, for the programme design, that are sequenced based on the focus of individual phase and programme content-specific learning objectives. The complete description of the model along with an example of its implementation is provided in section 3.

A total of 23 participants, from the Electrical, Electronics, Computer Science and Mathematics domain attended the programme. Session worksheets, lesson plan, questionnaire survey, and focus group discussions were used as instruments to evaluate the programme. The following are the investigated research questions:

1. How did the participants fare in the alignment and integration of modules?
2. What are the perceived changes in teaching practices as a result of the workshop?
The results of evaluation showed that more than half the participants obtained medium or higher scores (4-9) in the alignment modules within training. The mean scores of instructional strategies and learning objectives (1.73 out of 3) were better compared to the modules involving assessment strategies. Also, participants started using student-centered teaching-learning strategies within their lesson plans as against the traditional lecturing. This hinted at a conscious shift of the faculty towards student-centered strategies for achieving better student learning outcomes. The results from STTP evaluation led us to conclude that A2I model provides teacher educators with a robust solution for quicker adaptations.

2. Related Work

There is an increasing need for faculty development programmes to focus on the alignment between domain content with assessment and instructional activities to help them engage in scholarly teaching (Stevler et. al., 2012). This is found to be both challenging and time consuming (Conole & Fill, 2005). The typical implementation of these programmes may be in the form of workshops/short-term training programmes, seminars, courses, mentoring etc. (Dettori & Forcheri, 2003; Felder et.al, 2011). There also exist longer faculty technology integration training projects like Communities of Designers, developed from generic framework of Technology Pedagogy and Content Knowledge (Mishra et. al., 2007).

The Course Design and Teaching Workshop at McGill University and National Effective Teaching Institute Program (NETI) at North Carolina University are two short-term training programmes (STTP) that specifically target the alignment. The former workshop employs the design of alignment of learner outcomes, instructional strategies and evaluation to redesign an instructor's own course (Saroyan, et al., 2004). The content of this workshop include modules like concept mapping and active learning strategies to empower the faculty. The NETI workshops focus on learning styles, outcomes, research based instructional strategies and evaluation, and are organized in two stages – NETI I (basic) and NETI II (advanced) (Brent and Felder, 2009). Within the Indian context, it is seen that National Institute of Technical Teacher Training have developed a programme for civil engineering educators (NITTRC, 2013) targeting alignment.

All the programmes discussed in previous paragraph recommend the professional development to start from an authentic teaching-learning problem. The Course Design workshop at McGill comes closest to our requirement of an STTP focusing on alignment. However the workshop implementation process requires months of prior coordination with participants before the actual start of the STTP (Saroyan and Amundsen, 2004). The NETI workshop process also have a time gap of 6 months between the basic and advanced levels, rendering it difficult to adapt. Thus there is an absence of validated teacher training models that allow quick adaptations into a short-term instructional development design programme (Felder et. al, 2011). The A2I model is proposed to address this gap. The model contains the three modules of Learning Objective, Instructional Strategy and Assessment distributed across three phases and is situated within the teaching-learning problem of the faculty. Technology Integration is considered as part of instructional strategy while designing the model.

3. A2I Model

The major goals of the training programme are: (a) To introduce research based student centric strategies that can be implemented by the faculty within their classroom. (b) To train the faculty in aligning Student Learning Objectives with Instructional strategies and Assessment. (c) To train faculty in technology integration with available resources in their classroom.

The main theoretical basis of the model is the idea of constructive alignment. Constructive alignment is achieved when the teaching learning activities and evaluation are aligned with the intended student learning outcomes (Biggs, 1996). The model incorporates the constructive alignment by (a) Selecting Learning Objectives, Instructional Strategies and Assessment Strategies as explicit contents and (b) Providing three phases of Attain-Align-Integrate that allows for knowledge of alignment between these contents. Research cites that constructive alignment has been successfully employed by faculty in course redesign and promotes deep learning among students (Wang et. al., 2013). The major contents are then dealt with using a spiral curriculum i.e. an iterative process of
revisiting the contents, with successive iterations looking at the topic in a greater depth for the learner to build on his initial understanding.

3.1 Features of A2I Model

The entire model (see Table 1) consists of the following design components:

Table 1: A2I model for Constructive Alignment in use of ICT

<table>
<thead>
<tr>
<th>Phase</th>
<th>Focus</th>
<th>Module</th>
<th>Format</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Topic</td>
<td>Learning Objectives</td>
<td></td>
</tr>
<tr>
<td>Attain</td>
<td>Introduction to concepts</td>
<td>Learning Objective - Sub Topics</td>
<td>Write phase wise learning objectives that focus on concept attainment.</td>
<td>Majority are Instructor led activity slices.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Instructional Strategy - Sub Topics</td>
<td>Write Phase Learning Objectives that will help participants align learning in the modules pairwise.</td>
<td>Majority are Participant driven individual activity slices.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assessment Strategy - Sub Topics</td>
<td>Write Phase Learning Objectives that will help participants integrate learning from the three modules.</td>
<td>Most of the activities are Participant driven collaborative slices.</td>
</tr>
<tr>
<td>Align</td>
<td>Depth in Concepts and Intro to Alignment</td>
<td></td>
<td></td>
<td>Examples of pairwise aligned modules in their course.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>An Integrated Lesson Plan for one lecture within their course.</td>
</tr>
<tr>
<td>Integrate</td>
<td>Depth in Alignment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Phases** - There are three phases viz., Attain, Align and Integrate that is based on the various contents at differing depth.

  In the attain stage, the workshop designer will have to concentrate on the participant attaining preliminary knowledge on the three core modules of Learning Objectives, Instructional Strategies and Assessment Strategies. The alignment phase of the workshop looks at pairwise alignment between the modules. The integration phase workshop looks at the constructive alignment of the three modules.

- **Focus** - This column specifies the focus of the designed activities in each phase.

- **Module** - This column deals with content dealt within the phase. It is further subdivided into

  - Topics and Subtopics - This specifies the various sub-topics dealt under the three main modules of Learning Objective, Assessment Strategy and Instructional Strategy.

  - Learning Objectives - This specifies the topic level learning objectives.

- **Format** - This refers to the way sessions are held. The detailed split up of format is provided in Table 2 below. A single session comprises of several activity slices that involve specific actions by the instructor and participant during the teaching-learning interactions. There are 3 main types of activity slices viz., Instructor Driven, Participant Driven Individual, Participant Driven Collaborative. The role of participant varies from a learner to that of a teacher across the various slices as shown in Table 2. The duration of an activity slice is also a key aspect, as studies show that the average attention span of an adult learner is nearly 20 minutes (Dukette & Cornish, 2009), which necessitates the span of instructor led activities to be lesser.

- **Output** - This specifies the tangible output at the end of each phase, which provides the learner with flexibility in application and the needed reflection on outcomes.

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3.2 Implementation of A2I model

The implementation of Attain phase for learning objective module is explained as an example. The module contained two sub-topics – What and Why of Learning objective. These sessions – a) explained the need for learning objective, and b) distinguished appropriate and inappropriate learning objectives. The total session spanned for 30 minutes with 5 activity slices. The first two activity slices spanned 15 minutes with more of Instructor led activities with participants being active learners. These were followed by three 5-minute slices of participant driven individual, collaborative and instructor led summary activities.

Table 2: Elaboration of Format within A2I model

<table>
<thead>
<tr>
<th>Activity Slice</th>
<th>Examples</th>
<th>Role of Participant</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor Driven (In)</td>
<td>Instructor presenting the content to the participants. Instructor summarizing the content to participant</td>
<td>Learner</td>
<td>Between 5~15 minutes.</td>
</tr>
<tr>
<td>Participant Driven Individual (PIn)</td>
<td>Participant writing examples in worksheets meant for pairwise alignment. Participant performing a microteaching activity with visualizations.</td>
<td>Teacher</td>
<td>Between 5~10 minutes.</td>
</tr>
<tr>
<td>Participant Driven Collaborative (PCo)</td>
<td>Participants collaborating to write a lesson plan for a single lecture. Participants involved in Think-Pair-Share activity for aligning instructional strategies with learning objectives.</td>
<td>Shuttles between Learner and Teacher</td>
<td>Maximum of 45 minutes.</td>
</tr>
</tbody>
</table>

4. Evaluation

The evaluation of the programme is done at the two levels of Learning and Behaviour (Kirkpatrick, 2006). This is supported by reactions of participants to the programme, evaluated through a questionnaire survey. A positive result would imply that an instantiation of the model has achieved them and thus provide validation for the model. The research questions for evaluating each of these constructs are:

RQ 1. How did the participants fare in the alignment and integration of modules? (Learning)
RQ 2. What are the perceived changes in teaching practices as a result of the workshop? (Behaviour)

The total number of participants was 23 and the sample for each analysis was chosen from this population based on the number of submissions of lesson plans, worksheets and survey forms. We have used a questionnaire survey and focus group discussions to capture the participant perceptions about the various aspects of the workshop. The questionnaire survey consisted of 24 questions divided into three sections - Design, Learning and Application, and was administered at the end of the workshop. 21 participants had responded to this survey and these were considered for the analysis. The questions used for analysis had a 5-point Likert Scale from Strongly Disagree to Strongly Agree. A question like “I intend to explicitly specify Learning Objective for my class.” directly captured the behavior of the participant at the end of workshop.

The evaluation also utilized lesson plan created in the integrate phase and technology integration worksheet created in the align phase. We analyzed the data of all participants who had submitted their worksheet using a custom evaluation rubric. The rubric consisted of 6 dimensions and 4 scales. Two raters were trained for the evaluation and the rubric had substantial inter-rater reliability (k=0.7) for two raters, after training. The workshop session on visualization had an individual worksheet in which participants had to write the visualization integration plan for achieving learning objectives in their chosen topic. This was also evaluated using the lesson plan rubric. After the completion of this
worksheet, participants performed a microteaching activity to explain their proposed visualization integration strategy to the others.

5 Results

As seen in Table 3, the participants have displayed sufficient mastery in individual modules of Learning Objective and Assessment Strategy with a mean score of 1.95 and 1.76 (out of 3) respectively. The participants are also performing better in the alignment of these two modules with a mean score of 1.76 (out of 3). This means that they would require more training within the alignment.

Table 3: Mean Scores for Attain and Align phases

<table>
<thead>
<tr>
<th>Module</th>
<th>ATTAIN</th>
<th>ALIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Objective (LO-3)</td>
<td>1.95</td>
<td>1.76</td>
</tr>
<tr>
<td>Instructional Strategy (IS-3)</td>
<td>1.76</td>
<td>1.19</td>
</tr>
<tr>
<td>Assessment Strategy (AS-3)</td>
<td>1.19</td>
<td>1.76</td>
</tr>
<tr>
<td>LO-IS (3)</td>
<td>1.76</td>
<td>1.14</td>
</tr>
<tr>
<td>LO-AS (3)</td>
<td>1.14</td>
<td>1.19</td>
</tr>
<tr>
<td>AS-IS (3)</td>
<td>1.19</td>
<td></td>
</tr>
</tbody>
</table>

The technology integration scores (in Table 4) also shows that more than half of the participants were able to score at least 2 out of 3, which gives a mean score of 1.67. This is giving a similar result of alignment as the LO-IS column in Table 3. Within the questionnaire survey, the participants have indicated high perceptions on learning about alignment but a common response in all 3 group discussions was that “[they] require more practice sessions to check whether what [they] are doing is right or not”.

Table 4: Technology Integration Score

<table>
<thead>
<tr>
<th>Rubric Scale</th>
<th>Missing (0)</th>
<th>Inadequate (1)</th>
<th>Needs Improvement (2)</th>
<th>Adequate (3)</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>3</td>
<td>1.67</td>
</tr>
</tbody>
</table>

In the questionnaire survey administered immediately after the workshop almost all the participants have positively agreed on their intent to implement learning within the workshop. 18 different participants had indicated their intention of using active learning strategies of Think-Pair-Share and Peer Instruction within their classroom. The analysis of the final lesson plans showed that 18 of the participants had also used these active learning strategies. This confirms a clear change in the mindset of the participants to consciously include student-centered approaches in their teaching-learning practices. Table 5 compares the data corresponding to the reported intentions to use strategies and actual use of strategies within the lesson plans. This shift was evident in the responses during the focus group discussions in which one group clearly identified that “[they] have to break the traditional way of teaching so that students can connect”. The discussion also had a larger share of participants opting for Peer Instruction as a possible choice over Think-Pair-Share. All of them had a strong buy-in to use ICT in the class in the form of visualizations.

Table 5: Intentions of use of Instructional strategy Vs. Actual strategies used in Lesson Plan

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Think-Pair-Share</th>
<th>Peer-Instruction</th>
<th>Visualization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intended (Actual) Use</td>
<td>12(10)</td>
<td>18(13)</td>
<td>12 (8)</td>
</tr>
</tbody>
</table>

6 Discussion and Conclusion

While answering the learning gains from the workshop, it is seen that participants show better gains at the attainment of individual modules. Higher scores are reported for alignment of instructional strategy and learning objectives (Mean score of 1.76 and 1.67 for Lesson Plan and
Technology Integration). This means that the programme fared better in alignment considering the challenges with short time duration reported in literature (Conole & Fill, 2005). In the current workshop, participants had opportunity to practice the alignment of instructional strategies with learning objectives during the microteaching activity. This might have had a positive effect on those alignment scores. But more importantly this also informs the future implementations of the A2I model to provide explicit practice for alignment of assessment strategies with the other two modules.

The second research question on the changes in faculty behavior was seen from the match between the actual uses of same strategies in the lesson plan with the numbers reported in the post-workshop survey. 18 participants had used active learning strategies within their lesson plan and also indicated the intention to use these in classroom in the post-workshop survey and focus group discussions. This confirms a conscious shift of the faculty behaviour towards student-centeredness as demanded by constructive alignment theory (Biggs, 1996).

Successful implementation of the training programme and the positive results in both learning and behavior indicates that A2I model can be utilized for designing teacher-training programmes in constructive alignment for use of ICT in engineering education. For faculty training programmes in Electrical, Electronics, Computer Science and Mathematics, the examples and design of the current STTP can be directly used. For other domains, the activity slices have to be modified based on examples relevant to those domains. The smaller participant strength and constraints for verification of actual classroom practices are two major limitations of this study.

Acknowledgements

We would like to thank all the research scholars and staff within our department who helped us during the design and implementation of this programme.

References

Analytical Evaluation of Technology Acceptance in Teachers Training of Primary Mathematics Education in Hong Kong: A Preliminary Study

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Abstract: Digital technologies have been introduced for the purpose of enhancing the learning and teaching effectiveness, and many tools are designed specifically for mathematics education. However, whether pre-service teachers will actually intend to adopt the software or not in their future workspace is an important question. Even if they do, it is important to study the reasons behind their decision in this particular local context, and how the training curriculum can assist them in fulfilling their teaching goals. In this paper, our aim is to study the technology acceptance of our pre-service teachers in primary mathematics education, and investigate the incentives behind their decision of adoption in our local context based on their technology-enhanced learning experience in our Institute. Using multiple-regression analysis, we examine the factors influencing the technology acceptance of the pre-service teachers in their future teaching career. Our goal is to provide preliminary insights into how technology is perceived by these pre-service teachers in mathematics education training and career. This insight will help us build a better analytical model for a more formal analysis in our future study that fits both local and global contexts.

Keywords: Technology acceptance; TAM; UTAUT; Teachers training; Mathematics education; Multiple-regression analysis

1 Introduction

Educational technology is a core part of the mathematics teacher education curriculum in our Institution. Students (pre-service teachers) often come up with innovative ideas in their lesson plan, yet apparently only a few intend to actually put these into practice in their future teaching. Our experience working with in-service teachers also turns to a similar observation. It is therefore our interest to understand their concerns in order to inform the design of an effective teacher education curriculum.

This paper reports part of our larger study to identify the factors of technology acceptance for both pre-service teachers and in-service primary mathematics teachers in our local context. For each case, an explanatory mixed method approach (Creswell & Clark, 2006) is adopted to study the participants’ concerns firstly by quantitative survey, and then secondly by in-depth qualitative interviews with selected participants to gain deeper understanding behind the statistics. Research in this area has been conducted mostly in the higher education setting (see, e.g. the meta-analyses in (Schepers & Wetzel, 2007; Šumak, Heričko, & Pušnik, 2011; Taiwo & Downe, 2013)), while to our best knowledge very little ongoing research has been done in the primary education sector especially in Hong Kong. Through our initiative efforts, the outcomes will inform the curricular design of pre-service teacher training programs and inspire further research in this area.

This paper covers the preliminary results of the quantitative survey with pre-service teachers. Background literatures are presented in Section 2, research methodologies in Section 3, and data analysis and discussion in Section 4. We will then conclude the paper and lay out the roadmap for future works in Section 5.
2 A Brief Description of Related works

The majority of existing studies in the area of technology acceptance take the approach of multi-variable quantitative analysis, which starts with a hypothetical model describing the relations among possible factors of technology acceptance. These studies consist of statistically testing the model using survey data in that particular context. Two popular models of this type are the Technology Acceptance Model (TAM) (Davis, 1985) and its successor, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003).

Early empirical studies following the TAM suggest that perceived usefulness and perceived ease of use of the technology are the fundamental determinants of the teachers’ behavior intention to use the technology (Davis, 1989). These in turn depend on other factors such as computer self-efficacy and attitude towards computer (see, e.g. (Teo, 2010)). However, subsequent studies show that the results may not be that conclusive on change of context (Schepers & Wetzels, 2007). Recently, a meta-analysis of 37 studies using UTAUT show that only the perceived usefulness (renamed as performance expectancy in the model) has a strong relation with behavioral intention, while all the other factors are weak although statistically significant (Taiwo & Downe, 2013). In fact, most of the studies in the literature have been conducted in the Western context, while there is evidence that their results are possibly not be generalizable to non-Western contexts. For example, Yuen and Ma report that perceived usefulness is insignificant among 152 student teachers in a part-time teacher education programme in Hong Kong (Yuen & Ma, 2008). Similarly, Lai et. al. studied 264 undergraduate students in Hong Kong and found that perceived usefulness only had marginal significance (Lai, Wang, & Lei, 2012). This could be a cultural phenomenon demonstrated by non-Western users, but no further analysis has been conducted on top of the results to verify this claim.

3 Methodology

The present preliminary study aims to analyze the technology acceptance of a group of pre-service teachers studying primary mathematics education at the Hong Kong Institute of Education. The questionnaire begins with a statement defining educational technology as any digital computer technology that could assist teaching either in the classroom or in after-class learning activities, but excluding usage in teaching preparation or administrative tasks. The questions consist of two parts. The first part (see Table 1) consists of items used in TAM and UTAUT studies to collect the participants’ perceptions on eight constructs related to technology acceptance, namely, Perceived Usefulness (PU), Perceived Ease of Use (PEU), Attitude (ATT), Social Influence (SI), Facilitating Conditions (FC), Self-Efficacy (EFF), and Anxiety (ANX), with minimal customization to fit into our specific context. The second part asks other general information about the participants, including their gender, year of birth, their experience of using educational technologies, whether or not they are willing to take part in the follow-up interviews of the study, etc.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Code</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived usefulness (PU)</td>
<td>PU1</td>
<td>I would find educational technology useful in my teaching.</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td>Using educational technology enables me to accomplish teaching tasks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>more quickly.</td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td>Using educational technology increases my productivity (i.e.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>accomplishes more with less effort and time).</td>
</tr>
<tr>
<td></td>
<td>PU4</td>
<td>Using educational technology will increase my chances of getting a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>promotion.</td>
</tr>
<tr>
<td>Perceived ease of use (PEU)</td>
<td>PEU1</td>
<td>My interaction with educational technology would be clear and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>understandable.</td>
</tr>
<tr>
<td></td>
<td>PEU2</td>
<td>It would be easy for me to become skillful at using educational</td>
</tr>
<tr>
<td></td>
<td></td>
<td>technology.</td>
</tr>
<tr>
<td></td>
<td>PEU3</td>
<td>I would find educational technology easy to use.</td>
</tr>
</tbody>
</table>
Learning to use educational technology is easy for me.

Using educational technology is a good idea.

Educational technology makes my work more interesting.

Educational technology is fun.

I like using educational technology in teaching.

I believe that people who influence my behavior will think that I should use educational technology.

I believe that people who are important to me will think that I should use educational technology.

I believe that the school will support the use of educational technology.

I believe that I will have the resources necessary to use educational technology.

I have the knowledge necessary to use educational technology.

I believe that a specific person or group (e.g., technical support team) will be available for assistance with difficulties using educational technology.

I could complete a job or task using educational technology... even if there was no one around to tell me what to do as I go.

...if I could call someone for help if I got stuck.

...if I had enough time.

...if I had access to the instruction manuals for the technology.

I fear about using educational technology.

It scares me to think that I could ruin my teaching using educational technology by making a small mistake.

I hesitate to use educational technology for fear of making mistakes I cannot correct.

Educational technology is somewhat frightening to me.

I intend to use educational technology in my future teaching.

I predict I would use educational technology in my future teaching.

I have actual plan to use educational technology in my future teaching.

Instead of using the structural equation modeling (SEM) approach in TAM and UTAUT, we use a multiple-regression model as follows: First, an initial model is formulated, named R0, which assumes that behavioral intention (BI) to use technology is a linear function of all the other seven constructs. Moreover, as inspired by UTAUT, gender (GDR) is considered a moderator of perceived ease of use, social influence, and perceived usefulness, while experience (EXP) is considered a moderator of perceived ease of use, social influence, and facilitating conditions. Both moderators are included as categorical variables in the linear equation. Experience is classified as either low, medium, or high according to the students’ past exposure to educational technologies. Next, stepwise regression (Hocking, 1976) is applied to eliminate variables from the initial model by minimizing its AIC (Akaike, 1974). The resulting model is named R1 and the coefficients are used to identify the important constructs. This approach of variable selection is only possible in multiple-regression. Although not as sophisticated as SEM, it allows us to examine different variants of the model empirically to find alternative models that better fit the data and are still theoretically reasonable. This insight will help us build more reasonable models for our next stage of study using SEM.

4 Results And Analysis

4.1 Results of the Responses

A total of n=166 valid observations were collected in the study. For the final model R1 consisting of 10 independent variables, this exceeds the rule of thumb suggested by Tabachnick & Fidell (2012) requiring at least 50 + 8 × 10 = 130 observations for regression. The corresponding student gender profile is tabulated in Table 2, and the experience profile in Table 3. Descriptive statistics of the constructs are given in Table 4. Inspection of
the box plot of these distributions shows that they are not exactly normally distributed but all follow a bell shape. We will therefore use the data as-is without transformation.

Table 2: Gender profile

<table>
<thead>
<tr>
<th>Year of Studies</th>
<th>Female</th>
<th>Male</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>28</td>
<td>18</td>
<td>46</td>
</tr>
<tr>
<td>Year 2</td>
<td>72</td>
<td>21</td>
<td>93</td>
</tr>
<tr>
<td>Year 3</td>
<td>12</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Year 4</td>
<td>7</td>
<td>6</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 3: Experience profile

<table>
<thead>
<tr>
<th>Year of Studies</th>
<th>EXP(Low)</th>
<th>EXP(Medium)</th>
<th>EXP(High)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>18</td>
<td>20</td>
<td>8</td>
<td>46</td>
</tr>
<tr>
<td>Year 2</td>
<td>32</td>
<td>33</td>
<td>28</td>
<td>93</td>
</tr>
<tr>
<td>Year 3</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Year 4</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 4: Descriptive statistics of UTAUT constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Construct</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU (Perceived Usefulness)</td>
<td>3.74</td>
<td>0.60</td>
<td>FC (Facilitating Conditions)</td>
<td>3.61</td>
<td>0.60</td>
</tr>
<tr>
<td>PEU (Perceived Ease of Use)</td>
<td>3.55</td>
<td>0.76</td>
<td>EFF (Self-Efficacy)</td>
<td>3.67</td>
<td>0.58</td>
</tr>
<tr>
<td>ATT (Attitude)</td>
<td>3.81</td>
<td>0.67</td>
<td>ANX (Anxiety)</td>
<td>2.72</td>
<td>0.85</td>
</tr>
<tr>
<td>SI (Social Influence)</td>
<td>3.48</td>
<td>0.61</td>
<td>BI (Behavioral Intention to Use)</td>
<td>3.59</td>
<td>0.68</td>
</tr>
</tbody>
</table>

The resulting R1 model explains 56.39% of the variation in BI. The variables included in both models, as well as the R1 coefficients and their statistical significance are indicated in Table 5. Coefficients with p-value greater than or equal to 0.05 are marked as “N/S” (not significant) in the table.

Table 5: Model specifications and R1 regression coefficients (*: p<0.05, **: p<0.01, ***: p<0.001)

<table>
<thead>
<tr>
<th>R0</th>
<th>R1</th>
<th>Results</th>
<th>R0</th>
<th>R1</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>(Intercept)</td>
<td>N/S</td>
<td>EXP(Medium) x PEU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU</td>
<td>PU</td>
<td>0.30***</td>
<td>EXP(Medium) x SI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEU</td>
<td>PEU</td>
<td>N/S</td>
<td>EXP(Medium) x FC</td>
<td>EXP(Medium) x FC</td>
<td>N/S</td>
</tr>
<tr>
<td>ATT</td>
<td>ATT</td>
<td>0.34***</td>
<td>EXP(Low) x PEU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td></td>
<td></td>
<td>EXP(Low) x SI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC</td>
<td>FC</td>
<td>N/S</td>
<td>EXP(Low) x PEU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EFF</td>
<td>EFF</td>
<td>0.25***</td>
<td>GDR(M)</td>
<td>GDR(M)</td>
<td>0.16*</td>
</tr>
<tr>
<td>ANX</td>
<td></td>
<td></td>
<td>GDR(F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP(High)</td>
<td>EXP(High)</td>
<td>1.69**</td>
<td>GDR(M) x PU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP(Medium)</td>
<td>EXP(Medium)</td>
<td>N/S</td>
<td>GDR(M) x PEU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP(Low)</td>
<td></td>
<td></td>
<td>GDR(M) x SI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP(High) x PEU</td>
<td></td>
<td></td>
<td>GDR(M) x PU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP(High) x SI</td>
<td></td>
<td></td>
<td>GDR(M) x PEU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXP(High) x FC</td>
<td>EXP(High) x FC</td>
<td>-0.47**</td>
<td>GDR(M) x SI</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The findings are summarized below:
1. Of the seven constructs considered in the model, only perceived usefulness, attitude, and computer self-efficacy have statistically significant impact on behavioral intention. In particular, perceived ease of use is not proven to be statistically significant.
2. Experience is a strong moderator. High experience increases the intention to use the technology in the future.
3. Male students tend to have slightly stronger intention to use the technology.
4. Interestingly, if a student already has at least one semester of experience using educational technology, better facilitating conditions decrease rather than increase the students’ intention to use the technology in the future.

4.2 Discussion

The results that perceived usefulness has a direct impact on behavioral intention while the same is not true for perceived ease of use is in contrary to early typical results under TAM showing that both are statistically significant. The reason is yet to be found out in follow-up interviews, but one possibility is that the pre-service teachers are less concerned with the latter as they are not supposed to face the practical difficulties immediately. Indeed, these pre-service teachers are full-time students, and they are mostly facing challenges only up to the level of fulfilling the requirement of homework assignments or final projects, which are more or less the same with their peers in the same course. Their effort put into using any educational technology is under countable circumstances that they should be able to handle, such as presentation, group projects, or even teaching practicum. Since the curriculum is designed to give initial experience of formal teaching to the students, the effort expected from them is relatively small compared to real workplace. Thus, their perception in using educational technology for their work or study should not be comparable to in-service teachers or others who may constantly find new challenges at work. Yet, we think that the curriculum should be designed so that they can feel similar challenges in learning and using educational technology compared to post-graduation work. Our future work should be able to address these questions in depth.

For those already with some experiences using the technology, the negative relation between facilitating conditions and behavioral intention to use may be explained by their uncertainty in their future working environment and their inadequacy feeling in experiencing with educational technology. Our undergraduate students are only offered with one core course in how to use technology in their teaching mathematics. It could give the students a feeling of unimportance in using educational technology for teaching in the future. This could also explain why they believe they only have some experiences using the technology rather than none or high, and it fails to sustain their assurance in using it for professional work. Nevertheless, this uncertainty perception could be further investigated in our future qualitative work with interviewing these students.

It is also possible that some students misinterpret the questions, leading to error in their responses. While our questionnaire follows closely the design in the original paper by the proposers of UTAUT, which is presented in English, the majority of students in our sample are native Chinese speakers who may not be able to fully understand some of the questions in English as a second language. They may even hesitate to ask our assistants when they do not understand the questions in order not to project a bad image. One possible measure to take is to translate the questionnaire into Chinese using a back-translation process (Brislin, 1970). Some authors have shown that the UTAUT is robust enough to be used with translated questionnaire (Oshlyansky, Cairns, & Thimbleby, 2007). However, due to time constraint we have used the original English version instead.

5 Conclusions and Future Works

In this paper, our aim is to study the technology acceptance of our pre-service teachers in primary mathematics education, and investigate the incentives behind their decision of adoption in our local context. To the best of our knowledge, this is the first work undertaken in our Institute to study the perception of our students, who will soon serve as the major group of local teachers in primary mathematics sector. Understanding their perspective in technology-enhanced pedagogy is significant to the design of any advanced learning technology that is suitable
for their teaching. Our future work will attempt to further investigate their tendency in using educational technology with a more formal model, and study the reasons behind their choices through qualitative approaches.

6 Acknowledgment

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7 References


Assessing computer attitudes: Does it matter for teacher education in developing countries?

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**Abstract:** The digital education revolution has had a significant impact on the teaching-learning environments. In this new era, it is unimaginable to have technology illiterate teachers in classrooms. The demand for education reform in most developing countries has been growing ever since to ensure that teachers are equally proficient in both computer technology competencies and pedagogical content knowledge. The success of such educational reforms also relies on teachers’ attitudes and willingness to embrace computer technologies in the learning environment. To cope with these expectations, teacher training institutions should include computer related attitudinal objectives in their teacher training programmes. This paper explores the issues surrounding the assessment of computer attitudes among teachers and student teachers with the view whether such assessment matters in teacher education. The focus of this paper is guided by three relevant questions—“What is computer attitudes?”, “What affects computer attitudes?”, and lastly “Why measure computer attitudes?”

**Keywords:** Computer attitudes, teacher education, developing countries

1. **Introduction**

The rapid proliferation of the computer technology in the 21st century has had significant impacts on the teaching-learning environments. Realising the importance of ICT for education, governments in many developing countries have started to take incremental but concrete steps to bring the positive impact of ICT into the classrooms (Southeast Asian Ministers of Education Organization, 2010). For example, the Malaysian government spent almost USD 1.8 billion in the last decade to train teachers to integrate ICT in the classrooms and also to equip schools with adequate ICT infrastructures. The Malaysian Ministry of Education aims to improve the ICT device-to-student ratio from about 1:30 in 2011 to 1:10 by 2020 (Ministry of Education, 2012). In 2001, Vietnam announced its Master Plan for ICT in education for the year 2001-2005 which emphasised on infrastructural development and IT training (Peeraer & Van Petegam, 2011). The aforesaid initiatives are a testament to the growing concerns of developing countries in bridging the digital gap in schools.

As we progress into a technology-based society, it is imperative that teaching experiences with computers as effective pedagogical tools are made available to teachers (Teo, Lee & Chai, 2008). For this reason, there is great urgency for teachers to be able to use and integrate ICT effectively in the teaching-learning process. Teachers today need to develop their abilities and feelings of self-efficacy as they integrate computer technologies successfully as a teaching-learning tool (Wong, Jalil, Ayub, Bakar & Tang, 2003). In other words, teachers need to be comfortable with computer technologies and are able to consolidate and innovate their teaching (Heale, 2011).

The demand for education reform has been growing ever since to ensure that teachers are able to teach effectively with computer technologies. Education reforms in most developing countries have emphasised the need to integrate computer technologies into learning, teaching and assessment (Peeraer & Van Petegam, 2011). In fact, moving in tandem with this change, teacher education policies in many developing countries have also been reformed to ensure trainee teachers are equally proficient in both computer technology competencies and pedagogical content knowledge. The success of such
educational reforms relies on teachers’ attitudes and willingness to embrace computer technologies in the learning environment (Albirini, 2006). Indeed, Albirini (2006, p.386) stressed that “developing nations have the responsibility not merely to provide computers for schools, but also to foster a culture of acceptance amongst the end-users of these tools”.

To cope with these expectations, it is essential for teacher training institutions to include computer related attitudinal objectives in their teacher training programmes so that student teachers develop positive attitudes toward computer technologies. For this reason, the focus of this paper is to answer the question of whether it matters to measure teachers’ computer attitudes particularly in developing countries. The focus of this paper is guided by three questions— “What is computer attitudes?”, “What affects computer attitudes?”, and lastly “Why measure computer attitudes?”

2. What is computer attitudes?

Attitude is considered to be a very important concept from the social psychology point of view mainly because of its importance in social judgements and behaviours (Zhang & Sun, 2009). Attitudes guide behaviour and “favourable attitudes predispose positive responses to the object and unfavourable attitudes predispose negative responses” (Ajzen & Fishbein, 2005, p.17). Ajzen (1988) classified attitude into three distinct categories—affect (reflects feelings toward the attitude object, cognition (reflects perceptions and information about the attitude object) and conation (reflects behavioural intention and action with respect to the attitude object). In an earlier study, Breckler (1984) also confirmed the three dimensional definition of attitudes by testing the tripartite model of attitude structure by Rosenberg and Hovland (1960).

It is widely believed that attitudes is formed after the individual is exposed to an object for a certain period of time. Therefore, it is possible that teachers would have developed some attitudes toward computers when they have been in contact with these tools either for personal or professional use. In the context of computers, Kay (1993) defined computer attitudes by drawing on the definitions proposed by Breckler (1984) and Ajzen (1988). He employed a four dimensional definition of computer attitudes—affect (feelings towards computers), cognition (perceptions of and information about computers), conation (behavioural intentions and action with respect to computers) and perceived behavioural control (perceived ease or difficulty of using computers).

Consistent with Ajzen and Fishbein's (1977) theory, Smith, Caputi and Rawstorne's (2000) defined computer attitudes as a person's general evaluation or feelings of favourableness or unfavourableness towards computer technologies (i.e. attitude towards object) and specific computer-related activities (i.e. attitude towards behaviours). Similarly, Divine, Wilson and Daubek (1997) defined computer attitudes as the level of affect one has for computers while Heinszen, Glass and Knight (1987) defined computer attitudes as people’s feelings about the impact of computers on society and the quality of life, and their understanding of computers. Igbaria and Parasuraman (1993) conceptualised it as a representation of individuals’ predisposition to react in a certain way toward them.

The aforementioned literature suggests that computer attitudes is a multi-dimensional construct and distinct in nature. However, it also suggests there is no one definite meaning of computer attitudes. There seems to be little consensus on the term used to define computer attitudes. The literature, however, does indicate that any scales intending to measure teachers’ computer attitudes should at least constitute one of these dimensions—affective, cognitive, behavioural and behavioural control. Interestingly, assessing feelings toward computers or affection (Heinszen at al., 1987; Divine et al., 1997; Smith et al., 2000) seems to be gaining prominence in recent years (Garland & Noyes, 2008) but Yang and Yoo (2004) stressed that the cognitive dimension should not be ignored as it is just as significant.

3. Why measure computer attitudes?

Salzer and Burks (2003) stressed that it is important to study computer attitudes because it is believed to have either positive or negative impacts on computer related behaviours. They asserted that the need to focus on teachers’ computer attitudes is even greater simply because they are responsible to ensure the
future generation are prepared to function adequately in a technological society. They warned that teachers with negative computer attitudes may inhibit their ability to educate students in the use of computers. Computer attitudes is believed to influence not only teachers’ acceptance of computers but their future use of computers in the classroom (Roussos, 2007). Teo et al. (2008) stressed that the main reason for assessing teachers’ computer attitude is its ability to predict computer usage. In other words, teachers with positive computer attitudes would have higher likelihood of integrating computer technology successfully in their teaching-learning process. Teachers would respond favourably to computer technology use (behaviour) when they possess positive computer attitudes.

This behaviour-attitude relationship stems from the Theory of Reason Action (TRA) by Fishbein and Ajzen (1980) which posits that behavioural intent is a pertinent determinant of behaviour. It also proposes that this intention to perform a behaviour is a combination of attitude toward performing the behaviour and subjective norm. This theory holds that attitudes is key to understanding human behaviour. Researchers have continued to research on computer attitudes and found it to be a significant predictor of behavioural intentions or behaviour. Luan and Teo (2009) reported that computer attitudes had the biggest influence on Malaysian student teachers’ intention to use computers in the future while Teo’s (2012) study among Singaporean student teachers also reported the same findings. The link between these two variables was also established in an earlier study by Sadik (2006) who provided evidence that the level of school computer use was affected by teachers’ computer attitudes in Egypt.

However, in recent years, many researchers have questioned the importance of measuring computer attitudes. There are researchers who strongly believe that attitudes construct is too trivial to be studied and excluded it from their model framework (Ma, Andersson & Streith, 2005). They are convinced that the attitude-behaviour relationship is weak and insignificant. Older and newer studies have shown empirically that computer attitudes does not have any effect on behavioural intention or behaviour (Davis, Bargozi & Warshaw, 1989; Teo, 2009; Nistor & Heymann, 2010). For example, Teo’s (2009) findings based on the structural equation modelling’s (SEM) suggested that pre-service teachers computer attitudes did not contribute to the total variance accounted for in technology use.

Yang and Yoo (2004), however, disagreed that computer attitude is insignificant. They suggested that Davis and his colleagues’ (1989) failure to find attitude to be a significant predictor of behaviour may have been due to the mixed measures of the attitude construct. In their opinion, cognitive and affective dimensions of attitudes are two different constructs and should not be measured together. According to them, this is mainly because only cognition has a stronger influence on behaviour than affection. For this reason Yang and Yoo (2004, p.20) argued that the anomaly reported in Davis et al.’s findings could have been “because the potentially significant influence of cognition was offset by the insignificant influence of affect”. Zhang, Aikman and Sun (2008) continued to investigate the nature of two types of attitudes—attitudes toward object (ATO) and attitudes toward behaviour (ATB). Their study showed that they are two distinct constructs and ATB fully mediates the role of ATO on the user’s behavioural intention to use a system. In other words, positive attitude toward computer technologies will only indirectly lead teachers to decide to use such technologies in the learning environments. Zhang et al. (2008) also cautioned that the mismatched between conceptualisation and operationalisation of attitude in past studies may have caused researchers to overlook the importance of attitudes in technology acceptance studies.

Understandably, appreciating and monitoring teachers’ computer attitudes is important in ensuring the success of computer integration in the classrooms. At the same time, understanding the antecedents of computer attitudes is equally important as it can lead to teachers forming more favourable attitudes toward computers. Thus, the next section will discuss the possible factors related to computer attitudes.

4. What affects computer attitudes?

It is important that student teachers at teacher training institutions receive adequate training to be able to integrate computer technologies effectively when they go back to schools as teachers. Teo (2008) warned that failure to do so will produce teachers who are ill-prepared to teach effectively with
computer technologies. For this reason, the preceding literature will not only focus on the antecedents of teachers’ computer attitudes but that of student teachers’ as well.

In general, it is believed that there are many antecedents of teachers’ computer attitudes. Two widely studied antecedents are the teachers’ perceptions of how useful and easy to use computers are. The relationships between these two antecedents and computer attitudes are deeply rooted in the TAM (Davis, 1989). The TAM posits that a user’s attitudes toward computer use is jointly influenced by how the person perceived the usefulness of a system and its ease of use. Findings from past studies have suggested that student teachers’ attitudes toward computer use are directly influenced by perceived usefulness and ease of use (Teo et al., 2007; Luan & Teo, 2009). Recent studies showed evidence that perceived usefulness and perceived ease of use have a direct effect and indirect effect on computer attitudes respectively among secondary school teachers (Moses, Wong, Mahmud & Abu Bakar, 2013; Wong, Osman, Goh & Rahmat, 2013). Suffice to say, when compared between the two factors, perceived usefulness is considered to be a stronger predictor on attitudes toward computer use than perceived ease of use (Teo, Lee & Chai, 2007; Luan & Teo, 2009). In essence, the aforesaid findings suggest that favourable computer attitudes is formed when both student teachers and teachers believed that computers are useful and easy to use.

Teo et al. (2008) also further suggested that apart from the two aforementioned factors, subjective norms can affect teachers’ computer attitudes. Their findings indicate that teachers’ computer attitudes are influenced by the views of people whom they regard as important in their lives. In other words, when teachers believe that important people such as school principals support their computer use, they tend to form more positive computer attitudes. Teo et al. (2008) proved that subjective norm does influence computer attitudes even when computer use in the classrooms is volitional and not mandatory.

In addition to perceived usefulness, perceived ease of use and subjective norms, Teo and Schaik (2009) found facilitating conditions to have a significant influence on computer attitude indirectly through perceived ease of use among student teachers. They defined facilitating conditions as factors that exist in the environment which a person believe have an influence over a his/her desire to perform a task (Teo & van Schaik, 2009) while Venkatesh, Morris, Davis and Davis (2003) explains it as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. In addition, technological complexity has been found to have a direct and significant impact on student teachers’ computer attitudes (Teo, 2012). It is defined as the degree to which a person believes that a system is relatively difficult to understand and use (Thompson, Higgins, & Howell, 1991). This means that when student teachers perceived computers to be low in complexity, the likelihood of them possessing positive attitudes is higher.

In a more recent study, the results of a study by Wong (2013) pointed to the importance of learning strategies in fostering more favourable computer attitudes among student teachers. Learning strategies such as attitudes, motivation, time management, concentration, selecting main ideas, study aids and test strategies were most significantly correlated with attitudes toward computers. Out of these seven learning strategies, only selecting main ideas was found to be the best predictor of computer attitudes. It could then be concluded that student teachers with the ability to identify important points in lectures and pinpoint pertinent concepts in reading materials will have more positive computer attitudes (Wong, 2013).

The aforementioned studies provide some evidence that computer attitudes are influenced by many variables. It is, therefore, possible to manipulate these variables to form more positive computer attitudes among student teachers and teachers. At the same time, past literature have also shown that non-manipulatable variables such as teacher characteristics are equally capable of affecting computer attitudes. For example, gender has had a mediating effect on computer attitudes based on many studies in the past 20 years (Wong & Hanafi, 2007). Male student teachers were found to possess more significant positive attitudes towards computer laptops than female student teachers (Kay, 2006). The gender gap reduced when both males and females were given access to 24-hour access to a laptop and the Internet. On the contrary, the gender gap between male and female teachers were not apparent when teachers have equal access to computers (Bakr, 2011).
5. Conclusion

To return to the main question raised in this paper—Does attitudes matter for teacher education in developing countries?, it would be reasonable to assume that the answer is a definite yes. Echoing Shaft, Sharfman and Wu’s (2004) point of view, Sadik (2006) stressed that computer attitudes is a very important variable to be studied in teacher education because computer attitudes when taken as an independent variable, it has the ability to predict teachers’ computer use in the classrooms. On the other hand, as a dependent variable, it is affected by many manipulatable and non-manipulatable antecedents. In other words, computer attitudes has an effect on teachers’ intention to use computers and at the same time, it can be changed and shaped to be more positive. Policy makers and curriculum planners must acknowledge the role computer attitudes plays in ensuring the success of computer integration in the classrooms. The author would like to stress that many of the aforesaid cited studies originated from the developed world, but strongly believes that studies undertaken in such countries are very relevant to developing countries despite the cultural diverse technology users. Clearly, developing countries are implementing education reform policies aimed at matching the technological advances of developed countries. In a nutshell, computer attitudes is too important to be missed, more so for teacher education in developing countries.

References


Construction of Web Communication System to Support Young Teachers’ Training

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Abstract: There are numerous small-scale public schools, including on remote islands and in other locations, in Kagoshima, Japan. Therefore, we suggest a method of mentoring between young teachers via the Internet because it is difficult for persons to meet in many of these areas. We added three functions to the existing portfolio system and constructed a web communication system that young elementary and junior high school teachers can use for support and to share ideas with each other on the Internet. The teachers used two systems, the comment column and the bulletin board, for different purposes. However, there was considerable variation in the use of the system. Moreover, to improve the use situation, we found that it was necessary to make the system compatible with a mobile phone, making it possible to exchange opinions, and study the applicable scope of communication on the Internet.

Keywords: Communication, Internet, system development, young teachers’ training

1. Introduction

1.1 Background

It is necessary to improve the qualifications and the quality of teachers generally in Japan. It has been suggested that there should be a plan for helping a teacher continue to develop throughout the entirety of her/his professional life as part of the second basic plan for the promotion of education by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), 2013. It has been suggested that on-the-job training should be structured through cooperation and collaboration among metropolitan and district boards of education as well as universities because this approach can lead to greater enhancement and advancement of on-the-job training, including young teachers’ training.

We have constructed an “assessment system to visualize a teacher’s formative process and achievement” and attempted to unify “teacher training and training function through the graduate’s follow-up survey.” This is because we must respond to social needs which are training of teachers in advanced practical skills and conforming to the image of the teacher in society, among students, graduates, and faculty members. In a study on the “construction and use of the education system which contribute to the formation of the professional ability of the teacher” 2010–2012, we discussed the skills required for a teacher, which consisted of nineteen items in five categories, and developed a system to show a teacher’s ability visually and an assessment that aims at enhancing and deepening teaching skills of students in a teacher training course that is recorded in a portfolio. This approach is based on a portfolio, the purpose of which is to support a teacher after graduation, and which is used as a tool to help young teachers understand how they can develop professional abilities and to support their reflection (Faculty of Education, Kagoshima University, 2013).

However, there are many small-scale public schools, including on remote islands and in other locations in Kagoshima, where it is difficult for teachers to obtain such support: it is 43.4% of all elementary schools; it is 40.6% of all junior high schools. The national average is 19.5 teachers per school in elementary schools and 23.7 teachers per school in junior high schools, but in Kagoshima there are a relatively small number of teachers per school: 13.1 teachers per school in elementary schools.
schools and 17.8 teachers per school in junior high schools (MEXT, 2012). Recently, schools have conducted collaborative meetings, but there has been little discussion related to communication between co-workers who are young and inexperienced and their seniors. Therefore, it is difficult for teachers to discuss difficulties they face in teaching and to support each other.

1.2 Purpose of This Study

To address the above issue, we constructed a web communication system for young elementary and junior high school teachers using an existing portfolio system in cooperation with the board of education in Kagoshima. The system enhances mentoring by enabling young, senior, and similar young teachers, who are not mentors, to form a relationship (Rhodes, Stokes, & Hampton, 2004). There is a case in which a mid-level leader and a similar age group as well as an instructor mentored young teachers during their training in Japan (Shimada, 2012). However, it is difficult for teachers to meet in many areas on remote islands and other locations. Therefore, we suggest mentoring between young and similar young teachers through the Internet.

Therefore, the purpose of this study is to extend the functions of the existing portfolio system and construct a web communication system that young elementary and junior high school teachers can use to support each other and share ideas on the Internet.

2. Extension of Functions for the Existing System

The existing system is a self-support web tool that a teacher may use to evaluate her/his self-growth and reflect on whether s/he has to improve certain abilities to improve her/his teaching skills. Each teacher has a user ID, a password, and a portfolio. S/he makes a record by the next flow every year.

i. S/he records goals (skills, abilities) for the year in April.

ii. S/he makes a record of her/his teaching (such as school affairs, workshops, and lessons).

iii. S/he evaluates her/his skills as a teacher and reflects on the year in March.

iv. S/he submits topics for consultation in the comment column as needed. A university instructor confirms and replies to the topics in the comment column, and in this way the teacher can receive advice from an experienced university instructor.

The existing system was tailored to an individual, but we thought that it might be reworked to promote communication between young teachers by providing materials for sharing information and exchanging opinions. In particular, the following utilization and effects are expected.

- Young teachers utilize a web communication system to conduct a thorough investigation of each training problem through collaborating and exchanging information with each other.
- Young teachers who have similar professional teaching experience and are work at neighboring locations can discuss and perform mentoring on the Internet by sharing daily training problems and studying the problems together for a year.
- When they meet face to face, teachers can plan solutions to problems immediately because they have communicated about and shared topics through the Internet on a continuing basis.
- Teachers are able to receive a variety of advice and support from inspectors or school managers by becoming a member of the web communication system.

To realize the system described above, it must be possible for teachers to communicate through text, voice, and movies in a developed system. Therefore, through the extensions of function in this study, we implement communication functions based on the existing system to allow teachers to give advice and exchange opinions on the Internet.

2.1 Submitting Comments between Teachers

The existing system focused on a teacher’s self-evaluation of her/his skills, and did not have a function for the viewing of other teachers’ portfolios. Thus, it was difficult for a teacher to obtain advice and exchange opinions with other teachers by using the portfolio. Therefore, we implemented a comment submitting function for use between teachers. Moreover, we made it possible for a teacher, a school manager, an inspector, and a university instructor to view a portfolio, give advice, as well as exchange
opinions mutually. However, only the members who have access privileges to the portfolio through the access control, described below, can view and submit comments to the portfolio.

In particular, when a teacher submits a comment, “comment content,” a “contributor name,” and a “submission date and time,” these are shown in the comment column of her/his portfolio. At the same time, the other teachers are notified of the comment through e-mail, that they can access the portfolio. Thus, we hope to reduce the work involved in the teacher’s checking her/his portfolio frequently.

2.2 Access Control

The existing system is a self-support web tool that a teacher can use to evaluate her/his own growth. We can imagine that there might be teachers who do not wish for anyone to view their portfolio easily. However, there might be teachers who would like to receive instructions and advice based on their portfolios from an authorized inspector or university instructor to achieve their goals during the year.

Therefore, we devised the system so that the teacher who is the owner of the portfolio can control the access privileges for her/his portfolio every year (Figure 1). For example, when s/he had a problem in 2013 with “student instruction,” s/he could show the portfolio to other teachers who had the same problem, her/his own school manager, a university instructor, and an inspector who specializes in student instruction, and discuss her/his accomplishments and solution to the problem by receiving advice and exchanging opinions with the other individuals. In the setting window, a box is divided into two columns, and user names are listed according to access or no access. In other words, all the user names whose portfolios cannot be accessed are listed in the right-hand column, and the user names whose portfolios can be accessed are in the left-hand column. The user names in each box can be moved by using the “Add” or “Cancel” button.

2.3 Submission Classification Select in Bulletin Board

The comment column for each portfolio is intended mainly for one-to-one communication between teachers. However, in this study, we aim at facilitating mentoring by a number of teachers. It is therefore necessary to establish a virtual space for discussion in which a number of teachers can give advice and not just discuss one-to-one. When teachers talk about problems based on a text, it is necessary for a viewer to understand easily “what kind of answer a consultant finds.”

Therefore, we implemented a bulletin board system and a function by which a contributor can select what kind of answer s/he is looking for at the time of a submission (Figure 2). For example, we made it possible to choose from a selection of answers that are prepared beforehand, such as the contributor needs “counseling,” “a document,” “a practice example,” “advice,” “a tweet,” and “others.” In this way, we expect that both the sides—the viewer and the contributor—can discuss and respond smoothly.

In this bulletin board system, we implemented a function for attaching a file. The kinds of files that the teachers can attach are a Microsoft Office file, a PDF (Portable Document Format), a picture, and movies. Since teachers can attach pictures and movies, they can share, for example, part of their actual class, a review class, or a discussion between teachers. However, the upper limit of the file size that can be attached is 20MB because the disk space of the server is limited.
3. Evaluation

3.1 Research Method

This web communication system, which included the extensions discussed in the previous chapter, was implemented at August 2013 (Figure 3). We undertook a questionnaire survey for 17 teachers to evaluate this system in December. The survey items were as follows, and teachers used free description:

Q1. Did you use the web communication system after September? Why?
Q2. When did you use the bulletin board? When did you like to use it?
Q3. When did you use the comment column? When did you like to use it?
Q4. What do you think of the positive and negative aspects of exchanging opinions between teachers through the web communication system?
Q5. Do you have any question about the use of the web communication system?

3.2 Result

3.2.1 Utilization Situation

Six teachers answered “Yes” in Q1. In addition, two teachers answered “a little” instead of answering “Yes.” The reasons for responding “Yes” included “I thanked for teachers to visit my lesson,” “I could receive advices.” The reasons for answering “No” included “work and events were given priority,” “I did not feel the need to use it because I asked for advice directly from the same school teacher.”

3.2.2 Method for Utilization of Bulletin Board

There are frequent answers about ideas for lessons and class management in Q2, for example, “I asked about an idea for planning a class,” “I got advice when I prepared a teaching plan,” “I wanted to ask the opinions of teachers in other areas or at other schools when I planned class management and lessons,” “I got information about class management and learning instructions.” In addition, we found that teachers were positive about the possibility of using the bulletin board, for example, “I would like to use it as an
opportunity to cooperate actively between elementary schools and junior high schools,” “I would like to watch open classes and exchange opinions between teachers.”

However, unlike with the comment column, the bulletin board is not a system whereby a notice reaches other members when a member submits a message on the board. Therefore, it is a problem with the system that teachers cannot receive a response in a short amount of time when they would like to obtain advice. For example, we received the response “I would like to get a reply as soon as possible when I’m in trouble.” In addition, we found that teachers were anxious about submitting a comment on the Internet to teachers whom they did not know well, for example, “I was afraid that it was only a text how it would be received by others.”

3.2.3 Method for Utilization of Comment Column between Teachers

The teachers expressed that they would like to use the comment column when receiving professional support from university instructors and inspectors, in Q3. In addition, there was also a view expressed that teachers would like to use the system to contact each other, for example, “I suggest an answer for myself about a problem and receive praise for it from other teachers,” “I would like to use it for exchanging small amounts of information in the future.” However, the system is currently not used well in comparison with the above-mentioned bulletin board system because about half of the teachers answered that they “did not use” it.

3.2.4 Effect of Exchanging Opinions on the Internet

Teachers responded with a variety of opinions on both positive and negative aspects in Q4. A positive aspect is that a teacher can use the system to ask the opinion of others when there is not a partner physically present nearby, and moreover, there is no limit on the time and place, for example, “Even if members could not gather physically, I could submit the comment anytime,” “I could exchange opinions willingly, and there is little limitation on the time.” In addition, teachers can ask for a variety of opinions throughout the school because it is easy to share a topic on the Internet, for example, “I could get a variety of thoughts on one theme,” “I could ask others’ opinion on various viewpoints.”

However, a negative aspect is that it is not easy to have a connection and exchange opinions directly with a virtual connection on the Internet, for example, “It is difficult to ask teachers whom I have met only several times,” “I did not feel a need because it is best to ask teachers from the same school.” In addition, some teachers expressed the view that they would not be interested in using it because it requires work to maintain the system and the computer, for example, “I cannot readily become accustomed to connecting to the system because the computers that have the Internet are found only at the school,” “It is not simple to access the system, [it] needs to have a password input because it is too busy.” Therefore, there is a need for an input terminal, for example, “It is better to access it with a mobile phone,” and it is suggested that there is a need to develop an environment in which many members can frequently participate.

3.2.5 Unclear Points about Method for Utilization

There were a few teachers, as seen in Q5, who felt that the method for utilizing the system was unclear. However, we thought that it was necessary to promote regular use because the teachers answered, “I forgot how to use it when I used it again after a long absence.” In addition, the teachers answered, “The e-mail notification does not come to a mobile phone.” This is because the system may reject a computer domain e-mail due to restrictions by the Japanese wireless provider that may send unwanted e-mails to spam. Thus, it is necessary to alter the receive setting of the mobile phone for each individual contract so that the teacher is able to receive e-mail from the mail server that posts a notice.

3.3 Consideration

Concerning the users of the system, we can classify them broadly into the teachers who use it frequently and the teachers who do not use it at all. The teachers who use it frequently collected and submitted classroom newsletters, practices related to class management, ideas for lessons, writings on the
blackboard, and other activities along with the bulletin board system. However, the submission frequency for the comment column was less than for the bulletin board system, but the teachers used it often to contact each other and thank others in the comment column. Thus, we suggest that teachers should use the bulletin board system for collecting and submitting the information that they would like to save for a relatively a long time and use the comment column for short messages. The teachers should definitely be tactful about the use of the two different systems.

A problem to be dealt with in the future is how to improve the use situation. As one of the solutions, it is necessary to study the issues below:

- using it with a mobile phone, in response to the opinion “I would like to access the system with a mobile phone.”
- making a clear requisite, scale and inevitability for exchanging opinions on the Internet.
- studying the applicable scope of communication on the Internet in response to the opinion “It is good to make the consultation system on the Internet in case there is only one subject-based teacher in a junior high school or there are few training opportunities on a remote island.”

4. Conclusion

The purpose of this study was to extend the functions of the existing portfolio system and construct a web communication system that young elementary and junior high school teachers can use to support each other and share ideas on the Internet. We developed and added a function for submitting comments, an access control function, and a function for submitting selected classifications to the existing portfolio system, and implemented it. The results of the survey for the teachers showed that they used the two systems, the comment column, and the bulletin board, for different purposes. However, there was considerable variation in the use situation of the system. Moreover, to improve the use situation, we found that we have enable it to be used with a mobile phone, make it necessary to have exchange of opinions, and study the applicable scope of communication on the Internet.

In addition, we set up the system to send a notification e-mail when teachers submitted topics to the bulletin board after this survey, since it required a lot of effort for teachers to check whether a new topic was submitted, and they hoped that they would receive a notification e-mail from the system when a teacher submitted a new topic to the bulletin board. We hope that this will enable the use situation to be improved in the next year.

Acknowledgements and Additional Statement

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References

Detailed User Relation Visualization on Moodle

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Abstract: To enhance the learners’ performance and learning efficiency on e-learning platform is an essential issue in current teaching and learning engagement. This paper applies IT techniques and analysis methods to visualize the learners’ user relationship on the discussion board of Moodle based on the replying order and times they made in the selected topics/forum in a Moodle course, which will be very useful in the future for embedding the visualization into large-scale systems and further development of related applications. We mainly first extract the inner relation of users’ participation in one/several selected discussion topics or a whole forum of a certain course. Then we visualize the user participation relation using Scalable Vector Graphics (SVG) provided by D3.js with aesthetic graph visualization. Our visualization with directed graph (digraph) structures provides easy understanding of users’ network connections in topics/forum, and the weights of the connections indicating the replying times are shown both numerically on edges and visually by the thickness of edges. Digraph is applied here to indicate different replying order. We propose to perform visualization construction and representation via PHP with latest advanced programming libraries of jQuery and D3.js, while easy control of tree-structured menu for user relation visualization is realized by jsTree. In the experiments, our method consistently demonstrates high-quality detailed visualization of users’ underlying relation structure they belong to, which may benefit the further study of improving the learning efficiency on e-learning platform.

Keywords: User relation analysis, graph visualization, directed graph, Moodle platform

1. Introduction

The trend of teaching and learning in digital classrooms with the help of social network platforms (SNPs) and learning management systems (LMSs) requires the teacher to transform from traditional pedagogical practices to advanced and creative ones. Although it is the fact that more and more accessible learning data are produced and available in the e-learning systems during the teaching and learning periods, yet there are so many data generated throughout the formal and informal learning process. Hence it becomes much harder for teachers to understand the students’ performance within and after the teaching periods. To enhance the teaching and learning effects, students are encouraged to utilize the discussion forums embedded in the e-learning platforms (e.g. Moodle) for sharing ideas and helping each other in learning, which, in one aspect, helps to improve the teaching quality of the teachers, however, in another aspect, makes the user relation of the students in a course becomes more and more complicated. If such problems cannot be solved and the user relation information cannot be well extracted to inform the teachers to understand the students’ interactions in the discussion forums of the e-learning platforms, the teaching quality online may decrease and the teachers may fail to understand the students’ performance and guide the students’ learning directions.

To enhance the learners’ performance and learning efficiency on e-learning platforms and promote academic/teaching performance accordingly are essential issues in current teaching and learning engagement on e-learning platforms like Moodle. This paper aims at applying advanced IT techniques and analysis methods to study the learners’ user relationship on the discussion board of Moodle based on the comments, replying order and times they made in the discussion, hence the information extracted will become useful materials for future analysis of learners’ behavior online and even for providing suggestions to teachers as references for improving teaching quality in accordance to the needs of certain discussion topics and courses. The inner reason why we want to discover the user relation of a course or a topic online is that it will offer us better understanding of the key
interactions of the discussion for finding out related actions for steer the direction of the discussion while discussing. Again, visualizing the user relation also can let the teachers know the activeness and participation of the students during and after the discussion, hence the teachers can guide and help the students with special needs better in the e-learning process (Participation Map, 2013; Forum Graph, 2014). Through visualizing discussing topics with replying order and other related information such as replying times in discussion, it is possible to discover the underlying inner relation of users on related topics discussion or a course forum for learning enhancement purpose. In this paper, we apply hypertext preprocessor PHP with advanced programming libraries including jQuery, jsTree and D3.js to realize our detailed user relation visualization in the Moodle discussion forum.

2. Background of Study

Recently, researches about online relationship detection, analysis and visualization are becoming more and more popular. Our paper is made possible by the inspiration of previous work. Method for self-assessment in online discussion and co-occurrence relation discovery between keywords and learners are presented to analyze the content-based contribution making (Mochizuki et al., 2005), discussion relation is visualized through a Bulletin Board System. In addition to face-to-face participation relation researches, user relation on social media-platforms are investigated (Yndigegn, 2010), social encounters are found and can be extended by including them into online social networks. A boosting-based learning approach is presented to find and determine participation relation (Esuli, Marcheggiani, & Sebastiani, 2010), participation rather than selection of rich set features is preferred, and classification methods are utilized to decide correct assignment of relations. Given the observation of groups participated in similar tasks on online discussion community, participation relation frameworks are studied, and high online frequencies are found to be important to group relation cohesiveness (Chen, 2004). Framework that can be applied to scope eParticipation is proposed to study the participation areas and techniques online, and the framework enables better understanding of electronic participation (Tambouris, Liotas, Kaliviotis, & Tarabanis, 2007). In addition to participation user relation analysis, participation relation design is also studied. Engagement with dynamic relation design and applications provides new forms of participation online and offline (Hagen & Robertson, 2010). Platforms that allow social participation are investigated in (Kang et al., 2009), the relation between people and digital society are studied which will benefit participation platform architecture design based on user relation. Methods that can interactively and adequately model the relation in discussion forums based on social networks and dynamic information contents are required nowadays (Kim & Galstyan, 2010). Mainly, most methods currently focus on design and analysis of the relation of people on online platforms. However, the relations they process are mostly general-purpose relations of users in large-scale manner. There are very few methods specially designed to analyze the detailed user participation relation (user relation that keeps as much information as possible existed in the discussion) on certain topics and the whole forum on discussion board of e-learning platforms like Moodle, which is essential for enhancing reflective engagement of learners and promoting e-learning performance.

Recent advancement in online relation analysis provides ever-expanding possibility for studying the user participation relation on a discussion board. A discussion board is one type of social media, which is a good platform for investigating users’ daily performance and interests. Users’ performance on discussion boards are studied as reflection of their participation toward rich information world in (Shi, Zhu, Cai, & Zhang, 2009), different forum datasets are applied in their methods. In a cold-start problem, users only participate in some social relation, multi-relational factorization techniques are applied in (Krohn-Grimberge, Drumond, Freudenthaler, & Schmidt-Thieme, 2012) for extracting the underlying unknown user relation out of the social relation. A new social relation is investigated (Yuan, Chen, & Zhao, 2011), and the relation is combined with friendship, thus heterogeneous relations are fused together providing efficient recommendation over the networks online, which can further facilitate online discussion participation relation analysis. The structure of community is related to the social context of users’ activities online, a method is presented to detect community structure in social networks by analyzing time-based multi-relational datasets on discussion forums (Lin et al., 2011). As proposed long ago by Koll (1980), users’ behavior and comments are applied as concept relation for information retrieval and analysis, and knowing the
user participation relation on e-learning discussion board will help a lot in enhancing future teaching and learning activities. Currently, there are actually a few learning analytics and forum visualization tools like SNAPP (Bakharia & Dawson, 2011; Dawson, Bakharia, & Heathcote, 2010), Participation Map (2013) and Forum Graph (2014) that can provide simple relation visualization of the Moodle discussion forums. However, these tools mainly focus on simple user connection relation visualization of the whole discussion forum only, and many useful aspects in addition to the connection are not kept well. To the best of our knowledge, there is no method specifically designed to visualize the detailed user relation with rich additional information for both one/several discussion topics and the whole forum. On the contrary, detailed user relation visualization for both discussion topics and forums provides deeper participation relation analysis of learners engaged, and will further make the teachers understand the interactions among learners better in order to let them have sufficient interactions in e-learning communication, and can steer the steps of the students’ learning process.

3. Method

In this paper, we utilize hypertext preprocessor PHP with latest advanced programming libraries including jQuery, jsTree and D3.js to realize our detailed user relation visualization for both one/several discussion topics and the whole discussion forum in Moodle with directed graph structure. Since Moodle is designed and implemented in PHP, we apply PHP as the main data-fetching programming language for the major framework design and realization of our user relation visualization tool/plugin for easy compatibility and high running speed purpose. We also apply the latest advanced programming libraries of jQuery, jsTree and D3.js to enhance the overall effects of our user relation visualization, which allow multi-browser performance. The library jQuery is applied here to provide lightened structure of simplified client-side implementation, which enhances the user experience and accelerates the speed of the user relation visualization through analysis of replying order and times within selected discussion topics and a whole discussion forum of a course in the database. The library jsTree is utilized for providing academic/teaching staff with easy interactive control of the user relation visualization system, and jsTree will create a cross-browser easy control tree-structured component as viewable menu for teachers’ selection of interested topics/forum for user relation visualization. Figure 1 shows the tree-structured control menu of our user relation visualization in Moodle using jsTree. The library D3.js (D3 for Data-Driven Documents) is applied here to provide our system with aesthetic scientific visualization of the user relation for display purpose using the Scalable Vector Graphics (SVG), which enables graphics scaling while preserving the shapes of the user relation vector image. And D3.js will apply the user relation data fetched to drive the creation and control of interactive user relation graphics in different web browsers providing us with aesthetic scientific display of user relation in directed graph visualization forms (See Figure 2). With all these advanced IT techniques embedded, we’re able to discover the inner interactions of user participation in the
discussion forums, which can be further applied as guidance for directing user discussion activities on Moodle for enhancing students’ e-learning effects.

4. Experimental Results

In our experiments, we have set up Moodle 2.6.1 using PHP 5.4.24, MySQL 5.5.32 and Apache 2.4.6 in a Microsoft Windows 7 64-bit system on a Intel Core i7 2.70GHz CPU PC with 8GB RAM for testing our detailed user relation graph visualization tool for discussion topics/forums. We invited volunteer students online for participating in the discussion of 14 forums within 6 testing courses in our Moodle platform. We have validated the correctness of the user relation visualization by comparing the visualization data with the user relation data in the database. Hence, we will only show the user relation visualization results of the discussion in the Student Forum of the testing course “CENG1001 Programming in C++” shown in Figure 1 as an illustration of the effectiveness of our detailed user relation visualization, and totally there are 10 users discussed in the Student Forum of this testing course.

![Graph visualization of our detailed user relation visualization.](image)

Figure 2: Graph visualization of our detailed user relation visualization. (a) Graph visualization of user relation for a whole forum, (b) graph visualization of a selected user and his/her relation with the other users in the forum, and (c) graph visualization of user relation for selected topics in Figure 1.
Figure 2 shows the graph visualization of our detailed user relation visualization method for the testing course “CENG1001 Programming in C++” shown in Figure 1. From Figure 2(a), we can see that the detailed underlying user relation of the discussion in the Student Forum of CENG1001 is explained well through graph visualization. We can see the 10 users participated in the Forum discussion and their detailed connections with each other. In our method, if A replied B, there will appear a directed edge from A to B in our visualization. Hence, with directed graph (digraph) visualization, we can keep and show more essential information in the discussion. There are numbers on the graph edges, which is the weights of the directed relation. If A replied B three times, there will appear a directed edge with the weight of 3 from A to B in the visualization. Therefore, actually we apply weighted digraph as the vehicle for our detailed graph visualization to keep more essential information. Figure 2(b) shows the case when applying mouse selection of a certain user, then all the users and connections that are related to the selected user in the Student Forum will be visualized by our method. This facilitates the easy viewing of specified relation for a certain user from complicated graph visualization for a whole forum. If there are a large amount of users in discussion, this will in addition enhance clear visualization of the user relation. Our approach provides the tree-structured menu for easy selection and browsing of user relation visualization for the user-interested topics within a forum. A practical application is that teacher may want to know the performance of students in certain discussion topics in e-learning. Figure 2(c) shows the graph visualization of user relation for selected topics in the Student Forum of CENG1001 shown in Figure 1. We can see from Figure 2(c) that there are generally two separated weighted digraphs in the visualization, which means there are groups of users discussed in the selected topics where inter-group discussion never happened. In summary, the graph visualization offers clear display of the network connections among academic/teaching staff and learners in the discussion using weighted digraph, where the weights of the graph edges are indicated with not only numbers on the edges but also proportional thickness of the directed graph edges. Thus, with our visualization, we can provide academic/teaching staff with advanced IT tool for detailed user relation visualization for discussion of certain topics or a whole forum in Moodle courses, which may be further applied to promote the learning efficiency and performance of learners on e-learning platforms.

5. Summary

Existing forum visualization methods and visualization functions provided in the learning analytics systems mostly deal with simple user relation visualization, and only visualization for the whole discussion forum is provided in the current system, which is obviously not enough for the purpose of analyzing the detailed user interactions and enhancing the learners’ efficiency and performance on e-learning platforms like Moodle for teaching and learning engagement. In this paper, we present to apply hypertext preprocessor PHP with latest advanced programming libraries of jQuery, jsTree and D3.js to realize our detailed user relation visualization for both one/several discussion topics and the whole discussion forum visualization in Moodle platform. Participation relation digraph visualization via Scalable Vector Graphics (SVG) by the library D3.js is provided in our approach. The visualization offers clear display of the network connections among academic/teaching staff and learners with weights, where the weights of the graph edges are indicated with both numbers on the edges and proportional thickness of the edges. Easy selection of target topics/forum for visualization is achieved via the latest light-weighted programming library of jsTree, where a tree-structured menu is provided for topic/forum selection to control the user relation visualization. The experiments have shown the high-quality scientific visualization of users’ underlying relation structure of our detailed user relation visualization based on their interactions among each other in the Moodle discussion forum. Our future work includes investigating different robust user relation analysis and visualization methods like graph theory, and extending the user relation visualization to more complicated social network structures with discussion content analysis. We will also apply our visualization in real course forum discussion study to promote and validate the usefulness of our method.
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References


Development of Association Recommend Function for a Cross-curricular Subject Education Database as an Example in Disaster Prevention Education

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Abstract: This study would like to suggest an association recommend function as a framework to compensate for the shortcomings of the search type method, by incorporating a recommend type information collection into the database, in order to effectively support teachers working on disaster prevention education. The similarity scores of individual contents in an item base were calculated, and a plug-in which displays the association mapping based on the calculation was developed. As a result of operation verification, the achieved recommend information targeted by the purposed association recommends function could be visually displayed.

Keywords: Recommend system, educational database, disaster prevention education

1. Introduction

Disaster prevention education in primary and secondary education has become an important issue, because in Japan natural disasters are often. Disaster prevention education in elementary and secondary education can be divided into extracurricular activities such as evacuation drills and disaster prevention lectures, and curricular activities such as research studies of disaster areas during social studies and the study of seismic mechanisms in science class. Current disaster prevention education is mainly handled individually, such as a single extracurricular event, or even within a subject itself. In disaster prevention education, it is necessary to consider the systematic-systematic teaching content (Sakurai, 2013). However, it is pointed out that practice of disaster education is difficult, because the disaster education includes a wide range of disciplines (Kishida et al, 2009).

Although class time is limited, measures can be suggested to enhance the effect of disaster prevention education, which will further gain importance in the future. For example, cross-curricular subject education can overcome the barrier between subjects and within/outside a subject, by promoting coordination between subjects or adding a new subject viewpoint in extracurricular activities. In addition to being time efficient, the contents can be taught from two or more viewpoints at the same time in a set time. This is considered to be connected to the establishment of knowledge by multifaceted connection, and the acquisition of “useful knowledge” which can promote the appropriate activities.

However, there are many obstacles in carrying out cross-curricular subject education. For example, while a junior high school science teacher may be able to explain the mechanism of a tsunami; this is difficult for teachers who do not teach science. Similarly, it is difficult for science teachers to teach subjects other than science. Elementary teachers can handle various subjects but each teacher has a different area of expertise outside the textbook. Under these conditions, a framework which can support teachers in the promotion of ideas leading to new application of cross-curricular subject education is needed.
For contents which are too large to browse personally, Ono, Asoh and Motomura (2011) classified the methods for a user to collect information into a search type or a recommend type. The search type is considered to be the conventional method used more frequently by teachers for class formation.

For example, Gijyutu.com (Gijyutu.com, 2014) gathers educational material for technical education, and various educational materials and practical ideas are stored as a database. Support from such an educational database can be seen in various areas. Not only on the Internet, but also various publications can be viewed as a type of database.

This kind of database is beneficial when designing a class, but most methods which use a database are premised by search type information collection by a teacher. However, search type information collection has the drawback of being a heavy burden for the teacher. This is also related to the problem that data in the database is not being utilized. Therefore, this study would like to suggest an association recommend function as a framework to compensate for the shortcomings of the search type method, by incorporating a recommend type information collection into the database, in order to effectively support teachers working on disaster prevention education.

According to Ono, Asoh and Motomura (2011), a recommend system should consist of a recommend engine which can predict the needs of a user and a user interface which displays the contents to the user. In this article, a specific recommend engine and user interface in the disaster prevention domain were experimentally created, and actual operations are reported.

2. Development

2.1 Specifications of “association mapping”

In the database which includes a mechanism to promote ideas leading to new practices as proposed by this article (hereinafter referred to as “this database”), the idea of an association search information display that expands an idea (hereinafter referred as “association”), as used in WebcatPlus (WebcatPlus, 2014), is thought to be more suitable than the generally used narrowing down search type. Clustering has also been used to display associated words in a concentric pattern according to distance from the search word in two dimensions. However, in many association systems, even though several association words are shown, which words should belong in different categories, as well as the strength or weakness of the words in relation to the search keywords, are not well reflected nor displayed in the same line. In this database, since various categories, such as school type and subject are thought to be set, visual information display (hereinafter referred as “association mapping”) in a concentric pattern as suggested by Akiguchi was adopted (Akiguchi, 2011).

Next, a method to consider how to recommend the contents (practical information and various resources) registered in this database was considered. Collaborative filtering is used to recommend the contents from many data sets. Collaborative filtering is largely divided between user based recommendations and item based recommendations. User based recommendations are suitable when the preferences of the user has original value, such as an EC production recommendation. Item based recommendations are judged only by similarity between items. In this database, item based recommendation is adopted since it is difficult to reflect user preference. To calculate similarity scores between items, the main body text, classification category, and tag of each content were targeted.

Various resources, such as practical information, educational material, thesis material, and survey material, exist in the targeted contents of this database. Furthermore, inclusion not only of text data, but also of images and movie data is expected. The database system itself must be able to flexibly process various data. Hence, use of CMS which is generally used to construct websites was decided and WordPress with a high world share was adopted.
WordPress is an open source CMS with high customizing flexibility and additional functions can be added as plug-ins. Plug-ins can be developed by PHP. Consequently, by using WordPress and developing the purposed associations recommend function as a plug-in, construction of a system with a higher degree of freedom was considered possible. A plug-in with a recommend function also exists in WordPress, but it only has a list type display.

From the above, we decided to achieve the purposed association recommend function as a plug-in for WordPress (hereinafter referred as “this plug-in”) by calculating the similar score of each content in the item base (hereinafter referred as article), and perform association mapping (hereinafter referred as “mapping”) based on the calculation.

2.2 Development of the Association Recommend Function
2.2.1 Calculation of Similar Score of Contents

This plug-in consists of three processes, namely 1) acquisition of related data from all articles, 2) setting of similarity weighting, 3) map creation and display.

For 1) acquisition of related data from all articles, the results of a morphological analysis for the text data of the main text body of the article, and the category and tag information set for the article, are acquired. An Internet service (Yahoo! Japan, 2014) which is provided as a Japanese language morphological analysis API, is used for morphological analysis of the text data in the text body of the article. The process is carried out in advance in order to increase the processing speed of the morphological analysis for all articles.

To carry out morphological analysis, three information items from the category and the tag of each article are abstracted from each article text in the WordPress database. Results of the morphological analysis are added to the database as meta information for each article.

In 2) setting of the similarity weighting, the system administrator can set the use rate of each information item when calculating the similarity score from the results of the morphological analysis and three information items of each article.

2.2.2 Preparation and Display Method of Association mapping

In 3) map creation and display, similar articles are plotted in two dimensions by the multi-dimensional scaling method, in order to present a map centered selection and display the article. First, the morphological analysis results of the entire article are acquired by repetition processing. Next, the posting ID of the selection and article display (which becomes the evaluation standard) is determined. Next, the Pearson’s correlation coefficient with other articles is calculated and the results stored. In that case, the calculated value is added by obtaining the weighting rate set in the basic settings, and set as the evaluation value.

By using the above evaluation values, and determining the distance between the article display and other articles by multi-dimensional scaling, a map which can respond to various display settings and display title length, can be drawn/displayed for the determined distance between the articles.

3. Implementation

3.1 Implementation

This plug-in was installed in a Linux, Apache 2.2.16, PHP 5.2.17 and MySQL5.5.1 environment. WordPress 3.8 was used for CMS. PHP and JavaScript were used to develop this plug-in. Moreover, Clickable CanvasjQuery (Wizard cord, 2014), a jQuery plug-in, was used for mouse event processing.
This plug-in can be assembled from the WordPress managing screen, after downloading and installing the plugin in the WordPress plug-in folder. Various settings can be set from the settings screen. First, morphological analysis of entire article is carried out using Igo, a morphological analysis engine by YahooAPI on the “Recommend Information Map.” The administrator directs the start of morphological analysis by pressing the button (Figure 1).

Next, on the Basic Settings page, the similarity weighting of the article text body, Tag (Default Value 2), and category (Default Value 2) are set. Default weight values are set as 6, 2, and 2, respectively, for a total of 10, with weighting of the article text body is prioritized. At the same time, map settings for article display number (Default Value 8), balloon size of the article title (Default Value 100px), and display map size (Default Value 640×640) can be adjusted (Figure 2).

On the display screen of each article, the map image is displayed at the bottom of the article. By clicking on the image, the map can be displayed (Figure 3). By moving the cursor over the article displayed on the map (mouse-over), the entire title can be displayed. By clicking on a displayed article icon, display can be switched to the corresponding article. Also, the map can be enlarged or reduced for better readability.

3.2 Operation Verification

Fifty two articles were used as test data. These articles consisted of 47 implementation
reports/news (14 kindergarten/preschool, 15 elementary, 15 junior high and 7 high schools) from each school category, 1 report, 27 research thesis. Some of these articles overlapped categories. For example, the study contents related to disaster prevention education in “Geographical Field of Junior High School Social Studies” can be cited. The text body of the article can be considered to be related to the goal of study guidance procedures and disaster prevention education. Study guidance procedures are the basis for consideration of the educational contents of each subject. More specifically, since this study focuses on cross-curricular subject education which overcomes the barrier between subjects and within/outside a subject, by setting the study guidance procedures as the base, contents of displayed information can be verified, which is thought to standardize confirmation of association recommend function operations. Mapping with the default settings is shown in Fig. 3. Rating results which become the basis for mapping is shown in Table 1. Articles are sorted in the order of correlation strength with the source article. The category includes formal information of each article like kinds of school, grades, subjects, etc. The tag includes additional keywords of each article.

From the rating results, information beyond social studies and geography was displayed, such as a comparison of the contents of new and old studies in other subjects, including domestic science, and nursery implementation was displayed as related information. A total of 12 articles were tagged as study guidance procedures, but according the article text body and the category similarity, tagged information beyond study guidance procedures could also be displayed. From these results, we determined that the purposed association recommends function was achieved.

### Table 1: Result of a rating

<table>
<thead>
<tr>
<th>Rank</th>
<th>Article Summary</th>
<th>Category</th>
<th>Tag</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Source) Learning content of disaster prevention education in junior high school social studies geographical area &quot;</td>
<td>Junior high school, Social studies</td>
<td>Course of study, Social studies</td>
<td>0.98</td>
</tr>
<tr>
<td>2</td>
<td>Comparison of old and new disaster prevention education in the &quot;junior high school technology and home economics home&quot;</td>
<td>Junior high school, Home economics</td>
<td>Home economic, Course of study, Science</td>
<td>0.97</td>
</tr>
<tr>
<td>3</td>
<td>Learning content related to disaster prevention education in the &quot;High School Science&quot;</td>
<td>High school, Science</td>
<td>Course of study, Science</td>
<td>0.97</td>
</tr>
<tr>
<td>4</td>
<td>Learning content new and old comparison of disaster prevention education in the &quot;high school base fo home economic&quot;</td>
<td>High school, Home economics</td>
<td>Home economic</td>
<td>0.97</td>
</tr>
<tr>
<td>5</td>
<td>Prototype of disaster prevention education for children picture book that targets the historical earthquake of Akita Prefecture</td>
<td>Nursery, Practice</td>
<td>Picture book, Earthquake</td>
<td>0.97</td>
</tr>
<tr>
<td>6</td>
<td>Realities and challenges of creating a disaster manual and disaster prevention education and training programs of infant children with disabilities</td>
<td>Junior high school, Practice</td>
<td>Disabilities, Infant</td>
<td>0.96</td>
</tr>
<tr>
<td>7</td>
<td>Attempt of Disaster Education in Home Economics Clothing area</td>
<td>Junior high school, Practice</td>
<td>Home economics, Clothing</td>
<td>0.96</td>
</tr>
</tbody>
</table>

### 4. Conclusion

The purpose of this study was to develop an association recommend function as a mechanism to support teachers working in disaster prevention education. The similarity scores of individual contents in an item base targeting WordPress were calculated, and a plug-in which displays the association mapping based on the calculation was developed. As a result of operation verification, the achieved recommend information targeted by the purposed association recommends function could be visually displayed. In the future, we plan to increase the contents and carry out an evaluation test for teachers in greater detail. In addition, we plan to continue to consider the possibility of user-based recommendation function.

### Acknowledgements
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Digital Storytelling for Professional Socialization Through Cartooning Preservice Working Experience: A Case Study

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Abstract: New teachers are often shocked at real school situations such as rules of local schools, human relationships in an enclosed environment, and the reality of teaching children. Also, some teachers cannot adapt to the working situation and tend to leave the workforce within a few years. It has become necessary to educate student teachers in the universities with a focus on adaptive professional socialization of teachers to overcome this problem. In order to address this issue, we introduced digital storytelling so that student teachers can visualize the prospective image of their practicum before it begins, and then reflect on their working experiences at the school after their practicum, taking into consideration the school situations. This digital storytelling aims to broaden the student teachers’ perspective on schools as a workplace, by having them describe and share their working experiences. As a result, the student teachers could direct one’s attention to the different characteristics of various schools as well, rather than just focusing on their teaching experiences.

Keywords: Digital storytelling, cartoon, teacher education, professional socialization, practicum

1. Introduction

Many of the previous research focused on how to increase Pedagogical Content Knowledge (PCK) of teachers (e.g. Darling-Hammond & Bransford, 2005) when considering teachers’ adaptive metacognition of a new era (Lin et al., 2005). However, in order for teachers to adapt to tackle big complex problems at schools, there is a need to focus on teachers’ adaptive professional socialization (Zeichner & Gore, 1990).

The reason behind this is that the turnover rate within a few years of new teachers is high due to the reality shock they face, such as rules of the local school, human relationships, and the reality of the children (e.g. Hebert et al., 2001; Hong, 2010). As one of the reasons, a previous research pointed out that there is a gap between the teacher education at universities and the actual work at the schools, such as the teacher of the course not overlooking the pre-service teachers during the practice teaching. (Zeichner, 2010). While it has become a global trend for pre-service teachers to add on to their experience through long-term practice teaching, it is difficult for them to acquire sufficient professional socialization, since the experiences of teaching largely depend on the practice schools; they experience both successful as well as unsuccessful experiences; and the teaching of the university mentors during their practice teaching focuses mainly on PCK (Herbert et al., 2001).

We have provided a weblog community where pre-service teachers could have a dialogue based on their reports on experiences during their practice teaching, as a part of the preparation and reflection of the practice teaching (Mochizuki & Kitazawa, 2009; Kitazawa & Mochizuki, 2013). The closed community of pre-service teachers lack real-life working experiences in schools, so a course design where experienced teachers can participate, such as in pre-teaching and the weblog community, and motivate pre-service teachers to adapt professional socialization is needed. This previous research suggested that the weblog community became an important resource about professional socialization through not only providing opportunities to discuss and review mutually the practical knowledge which they learned during their practice teaching, but also through exchanging
information regarding how to communicate to children and other teachers which they could not learn at their universities, and about ways of adapting to problems at school. In order to promote the professional socialization of pre-service teachers, as a next step of our prior research, we wish to examine the effectiveness of digital storytelling which allows the pre-service teachers to share various information regarding the practicum schools deeply with the imaginary information of their experience. Our ultimate goal is to design a learning environment that will efficiently prepare teachers with adaptability skills and a realistic view of the real-world classroom.

2. Digital Storytelling and Professional Socialization of Pre-service Teachers

Digital storytelling as a reflective tool for teacher education portfolios has been explored for these years (Barrett, 2008; Kearney, 2009). Storytelling is the oldest means for communicating ideas, sharing meaning and developing community (Egan, 1995). Bruner (1991) argued that narrative is one of the cultural products utilized by the mind to construct its sense of reality, and finally he extends the concept of personally constructed narrative into the shared experience of storytelling thus allowing the merging of individual private experience into culturally negotiated universals (Bruner, 1996). Kearney (2009) explored to link the two dynamic processes of digital storytelling and portfolio development to promote deep learning, asking the freshmen student teachers to collect artefacts from their on-campus and field-based learning experiences that showed their understanding of becoming a member of the workplace in an actual school, and compose their portfolio in the form of a digital movie and text on a paper. However, this study only focused on teaching experience in the practicum and subject-based learning in their on-campus classes.

Although such reflective activity on learning subjects and teaching experience is important, the adaptive professional socialization of teachers cannot remain at the level of the classroom because such ecological conditions are themselves products of policy decisions, political actions, and other influences at levels beyond the classroom, and the student teachers often encounter such issues during their practicum. Fenstermacher (1980) has argued that teachers’ experiences with the institutional characteristics of schools are the most potent determinants of their perspectives toward teaching. We would like to explore the possibility of digital storytelling where the student teachers describe and share their working experiences in order to broaden their perspectives of schools as a workplace, which is associated with adaptive professional socialization of teachers. In order to help the student teachers create digital storytelling about their working experiences, the VoicingBoard (Suzuki, et al., 2008) is used for the simulation (Figure 1). The VoicingBoard system makes it possible to easily draw cartoons on Internet browsers. Users create cartoons by simply dragging and

![Figure 1. An example of usage of VoicingBoard, describing the teaching procedure.](image-url)
dropping actors from the actor list onto one of the cells. Deleting and copying an actor can be done by simply clicking on the function buttons. Background images are also provided to enhance the reality of the cartoon. This simple operation allows learners to draw and revise their own cartoons with greater ease. In addition, drawing cartoons using various actor characters encourages the users’ thoughts to be more actor-based because users are forced to select an actor first, before creating the story of the cartoon (Mochizuki, et al. 2010).

3. Research Design

3.1 Course Outline

The classroom practice which was studied in this research is “Pre-service Teacher Training 2,” taught by one of the authors at a private university in Japan from April to July 2013. This course was a lesson held before and after practice teaching in an actual school for two or three weeks as a pre-service training. The student teachers who participated in this study were seven senior students (five male and two female). In the sessions held prior to the practice teaching, the pre-service teachers aimed to prepare for the practicum, acquiring step-by-step the necessary teaching skills and to brush-up their skills to create teaching plans, blackboard writing plans, and educational materials, through mutual evaluation of the teaching plans and trial lessons with the practice school. The lesson after practice teaching aimed to create a teaching portfolio so that they reflected on their practice teaching. Regarding one of the students, the practicum at the school was held in November, so he did only the activities for preparation of his practice teaching Number tables and figures consecutively, not section-wise.

3.2 Development of digital storytelling about institutional experience in the course

Both before and after the practice teaching, the students were required to tell their experience in the form of a cartoon story. The first cartoon aimed to prompt the student teachers to imagine their life in the workplace including problems, accidents, politics, work besides teaching, etc.. The second cartoon aimed to encourage the student teachers to reflect on their experiences in the practicum from the viewpoint of the institutional characteristics of schools. After the student teachers created their cartoon stories, each of them was required to tell his/her own story, showing each panel of his/her cartoon, in front of other colleagues in the classroom, before and after their practicum.

3.3 Data collection

In this study, we acquired the following three data as preliminary evaluation. First, at the end of the course before the summer vacation, we conducted a questionnaire in order to gather subjective evaluation regarding digital storytelling. Secondly, based on findings of the questionnaire, we conducted interviews about the digital storytelling. Five students participated in the interviews. Thirdly, we analyzed the diaries written as weblogs to see how much the students wrote about working in school as teachers, and whether they have taken into consideration the institutional characteristics of the school.

Regarding the analysis, we referred to Hong (2010) who is exploring institutional factors as a reason for teachers leaving their jobs. Hong analyzed the relationship among six factors: 1) commitment, 2) value, 3) emotion, 4) micropolitics, 5) efficacy and 6) knowledge and beliefs. Therefore, in this research, we defined six categories: 1) commitment towards work, 2) value and standpoint as teachers, 3) emotion, 4) micropolitics, 5) efficacy and 6) knowledge and beliefs for teaching. Furthermore, to analyze the contents of reality shock and job adjustment (e.g. Weinstein, 1988; Herbert & Worthy, 2001), we created two additional categories: 7) expectations and the reality of schools, and 8) social behavior as professionals. In this research, we focused on a total of nine
categories (eight categories above-mentioned and 9) others), and we also analyzed the contents of the diaries and comments which was submitted to the weblog community.

The first author and the second author independently analyzed the categories of the diaries of the year 2012 and the year 2013. If the diary had multiple categories, we counted each category. Additionally, when opinions regarding categorization did not match, we decided through discussion. We have also collected the cartoons as data, but we will not refer to their contents in this research.

4. Findings

4.1 Subjective Evaluation of digital storytelling

Table 1 shows the results of the questionnaire regarding the storytelling. Although one student teacher could not answer the second question because his practicum did not start when the survey was conducted, we can see that the overall evaluations are almost all positive.

Table 1: Questionnaire regarding the storytelling

<table>
<thead>
<tr>
<th>Question item</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Creating the story prior to practice teaching was helpful in preparing for the practice teaching. ( n=7 )</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2. Creating the story after the practice teaching was helpful in reflecting about the profession and work life of teachers. ( n=6 )</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

4.2 Analysis of the Content of Diary Entries

Table 2 indicates the results of the analysis of the content of diary entries. We can see that there is an increase in diary entries in the categories of Commitment Towards Work, Micropolitics, and Social Behavior as Professionals. We can see that mentions of aspects of teacher’s work other than teaching, such as professional conduct as teachers and micropolitics within the organization, increased. This suggests that student teachers had become cognizant of the practical daily concerns of working as teachers.

Table 2: Results of the number of categorized diary entries within the weblog community

<table>
<thead>
<tr>
<th>Categories</th>
<th>Year 2012 ( n=8 )</th>
<th>Year 2013 ( n=6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diaries</td>
<td>Diaries</td>
</tr>
<tr>
<td>1) Commitment Towards Work</td>
<td>29/35.4%</td>
<td>51/62.2%</td>
</tr>
<tr>
<td>2) Value and Standpoint as Teachers</td>
<td>25/30.5%</td>
<td>21/25.6%</td>
</tr>
<tr>
<td>3) Emotion</td>
<td>50/61.0%</td>
<td>57/69.5%</td>
</tr>
<tr>
<td>4) Micropolitics</td>
<td>0/0%</td>
<td>6/7.3%</td>
</tr>
<tr>
<td>5) Efficacy</td>
<td>35/42.7%</td>
<td>53/64.6%</td>
</tr>
<tr>
<td>6) Knowledge and Beliefs for Teaching</td>
<td>49/59.8%</td>
<td>46/56.1%</td>
</tr>
<tr>
<td>7) Expectation and Actuality of Schools</td>
<td>27/32.9%</td>
<td>26/31.7%</td>
</tr>
<tr>
<td>8) Social Behavior as Professionals</td>
<td>45/54.9%</td>
<td>51/62.2%</td>
</tr>
<tr>
<td>Total</td>
<td>84 (Average 10.5)</td>
<td>82 (Average 13.7)</td>
</tr>
</tbody>
</table>
4.3 Student Teachers’ Reactions in the Interview

As mentioned above, before the practice teaching, the student teachers were asked to visually storytelling how they would imagine themselves to be acting in a classroom, which would be a new environment for them. A response by a student is as follows.

*I was wondering what the first day would be like, because I didn’t have any know-how. If I hadn’t drawn anything, it would probably been a very passive practice teaching experience. By drawing the cartoon, I was able to simulate what a day would be like, and think of what I would be doing. I think these are effects of drawing the cartoon. (Student C, male)*

Another student also expressed that by implementing storytelling that utilizes the VoicingBoard before the classroom practice teaching, the system aided her to simulate practice teaching and the actions and behaviors she would be taking in the school. This student's response supports the answer to the questionnaire, where a majority of the student teachers responded that storytelling before practice teaching was useful in preparing one's mindset and attitude. Furthermore, by implementing storytelling, there is a possibility that it promotes the students to think about preparing for practice teaching, or about the work and work life of teachers.

However, we also saw cases where some meaning was confirmed in storytelling before practice teaching, but the reality in the actual classroom differed.

*I think it was meaningful that we imagined what it would be like before the practice teaching, but the reality was quite different from what I had imagined. It was strenuous, problems occur, and the students didn’t respond. I imagined mostly positive things, but that was not so - rather, negative things happened more, so I would probably draw those things in the cartoon I’d draw after the practice teaching. (Student B, female)*

It is important that reality gaps such as this is avoided, but we consider it meaningful that the student was able to realize that there are gaps, and thought it was necessary to convey the discovery as a characteristic of the workplace.

After the practice teaching, we asked about the storytelling which the purpose is to reflect on one's actions during the practice teaching. We had the following response from a student.

*After drawing, I realized points where I thought 'I should have done this,' and unless you reflect on what happened, you tend to forget. It becomes a thing of the past. However, by drawing the cartoon, you remember and have a chance to reflect, and it becomes possible to pass down the knowledge by sharing on the weblog community or a diary. (Student C, male)*

As with the example above, all students who experienced practice teaching responded that conducting storytelling that utilizes the VoicingBoard after the practice teaching promotes reflection of the practice teaching and on oneself. Therefore, we found that storytelling both before and after the practice teaching is effective on promoting reflection. Furthermore, by creating stories based on their experiences and sharing them, the knowledge can be passed down and given as advice to future students (Schwartz, et al., 1999).

5. Conclusion and Future Issues

In this research, we implemented storytelling before and after the practice teaching, in order to promote the professional socialization of student teachers. Before the practicum, Student teachers shared their image of prospective practice teaching and a variety of their actual working experiences, focusing on various school’s characteristics. As a result, we can say that they were prompted to think about preparations for the practice teaching, and about the work and work life of teachers. Future avenues of research are recommended as follows:

- It is not yet relevant how storytelling influences the change in thoughts of an individual student. It is necessary to analyze from an organizational socialization perspective regarding the content
of the story and the process of the change; how the student captures the teaching profession in each process; and how they view their daily activities in practice teaching.

- It is necessary to analyze how the students process and give meaning to the storytelling of other students and their seniors.

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Do They Keep Technology in Mind? An Implementation of TPACK-oriented Science Teacher Program for Science Degree-graduated Students

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Abstract: Science-based education in 21st century needs qualified and innovative science teachers who are expert in using information and communication technology as pedagogical tool for their work and as cognitive tool for student learning. As such, a framework of Technological Pedagogical and Content Knowledge (TPACK) has been recognized as a theoretical basis for development of professional science teacher. This paper reported a pilot study result of implementing TPACK-focused preservice science teacher program for science degree-graduated students. The study participants were 54 preservice science teachers in a master degree of education at Khon Kaen University, Thailand. The alignment of 2-year courses has been particularly designed based on TPACK for students who graduated in 4-year bachelor degree of science. The results showed that the preservice science teachers have been cultivated their technological pedagogical knowledge (TPK) and technological content knowledge (TCK) during enrollment in the program. This could be implied that the TPACK-based approach should be used as a basis to create well-designed coursework in teacher education program.

Keywords: Technological Pedagogical Content Knowledge, preservice teacher, science education, teacher education

1. Introduction

In today’s world, information and communication technology (ICT) have become commonplace in improving and advancing the practice of education because of its potential of bringing about change in ways of teaching and learning. In light of technological advancement, in science education community of practice, there is a wide range of efficient technological environments and applications that can serve science teaching and learning (e.g. animations, simulations and modeling tools, microcomputer-based laboratories (MBL), intelligent tutoring systems, web resources and environments, spreadsheets, scientific databases, etc.) for both students and teachers (Srisawasdi, 2014). According to its features, these tools could provide opportunities for active learning, enable students to perform at higher cognitive levels, support constructivist learning, and promote scientific inquiry and conceptual change (Jimoyiannis, 2010). As such, there is a worldwide call for professional science teachers who are able to comprehensive use of ICT, and the challenge for teacher education in this century is to discover effective ways to prepare literate preservice science teachers and also to professionally develop inservice science teachers.

Over the last decade, traditional educational practice in teacher education no longer provide prospective teachers with all the necessary skills for teaching student to cope with this current knowledge-based society, especially in the fast changing world of early 21st century (Srisawasdi, 2014). Currently, Technological Pedagogical and Content Knowledge (TPACK) is a theoretical basis for development of teachers’ expertise with respect to the integration of information and communication tools (ICT) into teaching and learning activities for particular subject matter (Koh & Chai, 2011). TPACK illustrates essential knowledge of how teachers could integrate technological tools into their
teaching of specific content in their school practice (Jimoyiannis, 2010; Srisawasdi, 2012). Research indicated that the experienced teachers seem reluctant to incorporate educational technology in schools, while preservice teachers and newly qualified teachers are more confident users of educational technology in classroom and are more willing to learn and adapt educational technology in their classroom practices (Madden, Ford, Miller, & Levy, 2005; Sime & Priestley, 2005; Anderson, 2006). In science education, it is, however, still not clear how best to prepare science teachers who are competent in using and managing educational technologies to support their teaching practice and enhance students’ understanding about science (Srisawasdi, 2014).

To address the above issue, a pilot study was conducted to explore a preliminary result of an implementation of TPACK-focused preservice science teacher program for science degree-graduated students. This study seeks to describe preservice science teachers’ technological pedagogical knowledge and technological content knowledge after finishing one-year coursework in the program. Moreover, this paper aims to provide evidence of preservice science teachers’ use of the TPACK framework resulting from the preservice science teacher education program. Finally, implications for the design of preservice science teacher program for science degree-graduated students then are discussed.

2. Technological Pedagogical and Content Knowledge (TPACK) and Teacher Education

TPACK is currently an important fundamental framework in community of research and practice for educational research, especially in teacher education (Chai, Koh, & Tsai, 2010; Jimoyiannis, 2010; Srisawasdi, 2014). According to the framework, many studies showed that teachers who demonstrate TPACK can effectively integrate their knowledge of technology with their pedagogical and content knowledge to promote student learning (Niess, 2008; Harris and Hofer, 2011; So and Kim, 2009). In this light for science teacher education, both preservice and inservice science teachers are targeted to improve teaching proficiency based on the implementation of TPACK in many kinds of instructional intervention i.e. coursework (e.g. Niess (2005), Jimoyiannis (2010), Jang & Chen (2010), Srisawasdi (2014)), training (e.g. Hennessy et al. (2007), Guzey & Roehring (2009), Alayyar et al. (2012), and workshop (e.g. Annetta et al. (2013)). As such, it is clearly that the development of science teacher education program based on TPACK framework is important in order to prepare and cultivate science teacher for gaining high quality teaching competencies by integrating technologies into their science teaching practice.

3. General Description of Science Teacher Education in Thailand

In Thailand, there are two main pre-service science teacher education programmes. The 5-year undergraduate degree programme known as the Bachelor of Education (B.Ed.) programme is the programme which offer candidates the choice of teaching at either the primary or secondary levels of science education. The 5-year preservice science teachers have to enroll in all compulsory coursework for four years and then complete one year of school internship. The another preservice programme is 2-year Postgraduate Master of Education (M.Ed.) for teaching at the upper secondary education level for those who already possess at least a Bachelor’s Degree of Science (B.Sc.), called The Promotion of Science and Mathematics Talented Teachers (PMST) program. For this programme, the preservice teacher have to enroll in all compulsory coursework in three semesters for one year and then complete one year of school internship and conduct their Master’s degree theses at the same time.

4. Research Methodology

4.1 Study Participants

A total of 54 PMST preservice science teachers enrolled in Master Degree of Education in Science and Technology Education programme at Faculty of Education, Khon Kaen University, Thailand,
were the study participants. These teachers were in the third semester of their M.Ed. programme in academic year 2013. They were 14 preservice physics teachers, 20 preservice chemistry teachers, and 20 preservice biology teachers. They were 43 females and 11 males and they age between 23-25 years old. About twenty-five percent of the preservice teachers had a job before attending this programme and another just finished a Bachelor’s degree of Science. About fifty percent had experience working with children in a classroom setting or in a tutoring situation.

4.2 Details of the Course Arrangement

In order to cultivate TPACK for the preservice science teachers, a series of coursework in M.Ed. Science and Technology Education at Faculty of Education, Khon Kaen University was particularly designed for science degree-graduated student. At the faculty, preservice science teachers completed a sequence of five science education method courses across three semesters. The program faculty for science education teacher preparation had infused research-based strategies as well as student-centered approaches into the program. Thus, a commitment to modeling student-centered approaches and learning from authentic and up-to-date researches were evidence in the instructor’s values for these method courses. For example, the courses of technology-enhanced learning in science education was conducted in a manner that the instructor minimized content delivery via lecture and engaged students in many active learning activities, such as small group discussions, panel presentations, and team planning workshops, as well as the professional laboratory practice in science education. Also, scenarios, examples and problems that are important both in workplace and in society in general were crucial in these course. However, they also undertook four general methods courses in the first two semesters.

4.3 Data Collection and Analysis

The researchers collected data by considering the preservice science teachers’ poster presentation during an intensive seminar organized in the last three weeks of the third semester. All the preservice science teachers were presenters and they were assigned to create a poster and present their science teaching ideas and research in science education to science educators in ten minutes. After each poster presentation, they were asked by four science educators to clarify their thought for 5 minutes. The researcher performed the content analysis of the preservice science teachers’ TPACK based on their poster contents and presentations, and the question-answer session. Inter-rater agreement was conducted by two raters and the reliability was, finally, established a completed agreement. For this pilot study, the majority of the study was on the preservice science teachers’ technological knowledge (TK), technological pedagogical knowledge (TPK), and technological content knowledge (TCK) only. Each knowledge type was coded into three types of knowledge related technology in TPACK framework. Moreover, characteristics of TK-PK interaction and TK-CK interaction also were investigated in order to describe their thought about using technology in science teaching and learning. For TK-PK interactions, T-disassociated PK extents to which instructor uses technology separately from teaching strategy selected. T-assisted PK extents to which instructor uses technology as a supporting tool to teach following the selected strategy. T-enhanced PK extents to which instructor pedagogically involves technology into the process of learning by its nature, as a part of learning process. Finally, T-transformed PK extents to which instructor pedagogically use technology to transform regular learning process following a specific learning model or teaching strategy.

5. Results and Discussions

Results showed that about a half of the preservice science teachers (51.85%) thought about the use of technology in their own research and teaching ideas. From the content analysis, the preservice science teachers’ research and teaching ideas on the poster presentation were coded inductively and then identified their teaching idea on the use of technology. The results of technology used for their research and teaching ideas was presented in Figure 1.
A graphical representation of Figure 1 showed that the preservice science teachers favor to use digital technology in science lesson. Most of them (39.29%) recognized that scientific visualization technology such as simulation and animation was a pedagogic tool for science teaching and learning. About 14.29% of them who selected to use digital game & cloud technology, blended learning environment by microcomputer-based laboratory (face-to-face) and web-based inquiry science environment (online), and video-based teaching, respectively. In additions, they decided to use blended laboratory environment by microcomputer-based laboratory (actual lab) and computer simulation (virtual lab), and augmented reality technology in 7.14% each type. Only one of them (3.57%) decided to employ internet for student’s inquiry in science class.

In Figure 2 and 3 that follows, it presents the percentage of coded segments over the poster presentation for each of four categories of TK-PK interaction, and TK-CK interaction, respectively.
According to Figure 3, the result on TK-CK interaction revealed that 93.86% of them understood the ways to use technology to simplify scientific knowledge. In the other words, there was 42.86% of them could use technological tools to assist (T-assisted CK) the presentation of scientific knowledge to student. Another, they proposed to use technological tools in a manner of enhancement (T-enhanced CK) and transformation (T-transformed CK) of scientific knowledge in 25.00% each characteristics.

In a summary, the results of this pilot study provided evidences that the preservice science teachers’ TPK and TCK has been cultivated during their enrollment in the TPACK-oriented science teacher program for science degree-graduated student. This finding is consistent with Jimoyiannis (2010), Jang & Chen (2010), and Srisawasdi (2014) that implementation of well-designed coursework could foster preservice or inservice science teachers’ essential knowledge of TPACK. As the measure of the TPK and TCK, the results indicated that the preservice science teachers’ perceptual understanding on the ways to use technological tools to enhance pedagogy of science teaching (T-enhanced PK) is higher than others, compared to the use of technology to assist (T-assisted PK) and transform (T-transformed PK) the teaching of science. According to their TPK and TCK development, the preservice science teachers’ TPK was more prevalent than growth in their TCK. This finding is consistent with Graham, Cox, & Velasquez (2009) who have reported that science teachers significantly increased their TK, TPK, TCK, and TPCK after attending a university-based professional development focused upon content, inquiry-oriented pedagogy, and educational technologies, and the TCK had the lowest mean score for their development. However, the findings of this study clearly showed the need for further classes or coursework in order to complete preservice science teacher’s TPACK.

6. Conclusion and Implication

This paper reported a pilot study result of an implementation of TPACK-oriented science teacher program in context of two-year Master degree of Education in Science and Technology Education for graduate student who finished four-year bachelor’s degree of science. In TPACK-oriented science teacher program, the preservice science teachers have been fostered their TPK and TCK in science teaching and learning. In an effort to better serve the needs of high quality science teachers, the results of this pilot study illustrated that the TPACK-oriented program for science teacher could be particular considered as a potential attribute for development of science teacher education in future. Therefore, an implication of this is the possibility that TPACK-based approach for professional development should be implemented into courses of teacher education program in a long time in order to effect any lasting changes and completion in preservice science teacher’s TPACK.
Acknowledgement

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References


Evaluation of Three-Site Multipoint Distance Learning using High-Definition "HyperMirror"

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Abstract: The purpose of this study is (1) to provide information about three-site multipoint distance learning utilizing the high-definition “HyperMirror” and (2) to determine how the video image quality of standard definition and high definition affect distance learning. We carried out distance learning projects twice in 2010, on (a) January 28th [Standard Definition] and (b) February 24th [High Definition], with middle schools in Nara and Kumamoto and the High Energy Accelerator Research Organization, Tsukuba in Japan. The three locations successfully connected using HyperMirror during the projects. Afterwards, a questionnaire survey revealed that image quality was not the sole contributing factor in the overall assessment of HyperMirror. However, it was suggested that easy-to-see figures, pictures, and remote students’ facial expressions were important for students.

Keywords: Distance education/learning, HyperMirror, high-definition, multi-point

1. Introduction

A traditional videoconference or video chat transmits pictures that are captured by the camera for one-on-one or smaller group meetings, and the presence of another party and the atmosphere of the classroom are difficult to convey. As a solution to this, a special type of videoconferencing system called “HyperMirror” (HM) has been used successfully for distance learning. In HM, everyone appears in the same video image, in other words, everyone appears as if they are in the same room (Morikawa & Maesako, 1998). In comparison with the traditional videoconference, distance learning with HM has been confirmed to be more suitable for learning programs involving physical activities and sharing or interacting with documents/materials with the counterpart in a remote place (Imai, et al., 2002). In addition, HM proved that sharing the same space and working together virtually could make distance learning effective, despite the rather poor quality of image resolution (Matsukawa, et al., 2005).

Previous research on distance learning has shown to be of benefit of using high-definition (HD) rather than standard-definition (SD), e.g., it improved readability of text on the blackboard (Shimizu & Shiroma, 1990) and increased the feeling of high-presence distance education (Nishihara, et al., 2006)). In HM, the presented documents/materials were hard to see due to a lower-resolution format and insufficient bandwidth of the network. Therefore, HD technology was applied to HM with a wider bandwidth network, allowing a wider range of activities (Nakazawa, et al., 2009). However, whether the improvement of video image quality between SD and HD on HM affects participants’ feelings has yet to be elucidated. It is possible for HM to construct more than a two-site connection, although HM has so far been done in point-to-point mode. Therefore, HM has yet to be elucidated fully concerning multipoint distance learning.

Thus, in this study, distance learning projects were conducted twice in 2010 among middle schools in Nara and Kumamoto and the High Energy Accelerator Research Organization, Tsukuba in Japan. The purpose of the research is (1) to provide information about three-site multipoint distance learning with HM and (2) to determine how the video image quality of SD and HD affect distance learning.
2. Outline of Distance Learning

2.1 Session Dates and Participants

Distance learning with HM connecting three locations was conducted on January 28, 2010, (1st session), and February 24, 2010 (2nd session). The three locations connected by HM were the High Energy Accelerator Research Organization (KEK) in Tsukuba City, Ibaragi, “N” middle school in Nara, and “M” middle school in Kumamoto. “N” middle school is located in Nara City with about 400 students in the 1st–3rd grades (equivalent to 1st–3rd grades in junior high schools). “M” middle school is located in a mountain region with about 130 enrollments in total. Two experts in “KEK” and students in Nara (1st session: 29 students; 2nd session: 20 students) and Kumamoto (1st session: 40 students; 2nd session: 15 students) participated in the distance learning.

2.2 Learning Program

As part of the outreach activities in cooperation with KEK, Center for Educational Research of Science and Mathematics, Nara University of Education develops educational programs that allow many learners to experience research on leading-edge topics in particle physics. In this exercise, instructors from these organizations and schools had examined feasible curriculums at real teaching environments and taught on the basis of those curriculums. In addition to the two distance learning sessions examined in this paper, one experimental lesson was held at each school. In the 1st session, the video quality was SD, and it consisted of three types of activities: introductions of their schools and KEK, joint classes on introductory subatomic physics taught by experts of KEK, and practical work (for N, hands-on learning in making wire chambers; for M, hands-on learning in measuring the angle of cosmic rays). In the 2nd session, the video quality was HD, and the session involved assigning follow-up tasks to each presentation, Q&A, and comments from KEK. The learning environment is the main focus of this paper, not the contents of the learning program.

3. Educational Merits of Three-Site Multipoint Distance Learning

In distance learning, practices with a traditional point-to-point videoconference such as between schools have been reported by numerous researchers. However, connecting more than two locations such as the practice here of including expert organizations and schools to carry out distance learning was unheard of. By connecting with expert organizations such as KEK, the students were able to experience and learn advanced research while being in their classrooms.

In addition, when connecting multiple locations in the traditional videoconference, every site receives numerous connected images as one combined image by connecting to the MCU (multipoint control unit). However, here we used HM so that we could more closely simulate the normal classroom environment while in a distance learning environment. With HM, it was necessary for each site to directly send and receive images reciprocally because of the need to combine images at each site. Thus, it was significant to talk about the connections when there were three connecting locations involved.

4. Network and Equipment Configuration

4.1 Network

In the two remote sessions, the three sites were connected with different networks. For the 1st session, terrestrial lines were used. Although the line installed at N school in Nara was of optical fiber, the actual bandwidth was about 1.5 Mbps and not suitable for the remote session considering the amount traffic from devices in the school. Therefore, a classroom in Nara University of Education, Japan, was hired as the venue, where the university network was used for the session (100 Mbps).

As for Kumamoto, the line used for M school was “Community Access Television” (CATV).
The line was shared with the town house and other local facilities, and while the bandwidth of M school was 5 Mbps, a preliminary test found its capacity limit at around several hundred kbps, which was barely sufficient to host a videoconference. The image transmission bandwidth for the videoconference system on the session day was fixed at around 96–384 kbps.

The second session was carried out mainly via the network under Kizuna, the ultrafast Internet satellite. Transportable antennas were set up at N and M schools to conduct communications through Kizuna. At KEK, no antenna was set up. Instead, an antenna at JAXA Tsukuba Space Center was used for communication with Kizuna. The exclusive terrestrial line connecting JAXA and KEK and the long distance wireless LAN connecting Tsukuba University and KEK were used to establish connections with Nara and Kumamoto. The connection bandwidth via Kizuna was set at approximately 17 Mbps (dual-direction) for each school and about 13 Mbps (dual-direction) for connection between JAXA Tsukuba Space Center and KEK (using the exclusive terrestrial line and a long-distance wireless LAN). The available bandwidth between each of the three locations, when connected simultaneously, was about 6 Mbps (dual-direction). As for the image transmission bandwidth during the session, the communication using the videoconference system was conducted at 4 Mbps.

4.2 Equipment Configuration

As the first session was done on SD while the second was on HD, the two sessions used different converter configurations, but the basic structures were almost the same. The following section explains the detailed structure of the learning environment, as shown in Figure 1.

First, blue screens were set up at the three locations to combine the three images through chroma key synthesis. Images from the camera of the expert standing in front of the blue screen were combined with the computer screen showing the lecture materials, and then the synthesized images were sent to Nara and Kumamoto. At the remote locations in Nara and Kumamoto, images of participants standing in front of blue screens were sent to the other two locations. Syntheses of images at one site with images received from other two locations were separately done at each location in order to minimize the impact of transmission delay. At KEK in Tsukuba, images of the expert combined with the computer screen were synthesized with images from Nara, and images from Kumamoto were finally added to create an HM of the three locations. In Nara and Kumamoto, the respective images were first synthesized with the expert's images and then combined with pictures sent from the other school.

Figure 1. Simplified framework of distance learning with HM.

5. Scenes from the Distance Learning and Results of the Questionnaire Survey

5.1 Scenes from the Distance Learning

5.1.1 1st Session: HM with three locations via SD

At the first remote session, an SD network of HM connecting three locations was established. Although the resolution size was defined as SD, the network environment was limited as described before, so the image transmission bandwidth of the videoconference system was fixed at around 96 kbps between Tsukuba and Kumamoto, and 384 kbps between Tsukuba and Nara.

Figure 2 shows a scene from the actual distance learning. In this particular scene, five students...
from Nara entered the picture to make a presentation. Figure 3 is the image of the expert in Tsukuba giving a lecture. The expert held a pointer with a tip in the shape of a big arrow. Figure 4 shows the PC image in Tsukuba prepared for presentation materials. The PC displayed the synthesized image made in Tsukuba featuring real-time classroom scenes of Nara and Kumamoto, which were transmitted between Tsukuba–Nara and Tsukuba–Kumamoto via video chat software. By displaying the scenes in this manner, participants were able to share the same image and learn what was going on at the other two sites. However, due to the specification limit of the video chat software, the image could not be enlarged, making the expert in Tsukuba lean in close to check the screen.

Figure 2. Students of N giving a presentation. Figure 3. Expert lecturing with a background image. Figure 4. Real-time classroom scenes using video chats.

5.1.2 2nd Session: HM with three locations via HD

Figure 5 shows a presentation scene by students at the second remote class. In Figure 6, experts at Tsukuba were answering a question from students. Compared to the first remote session, the facial expressions were captured more clearly.

Figure 5. Students of N giving a presentation. Figure 6. Experts answering the question.

5.2 Results of the Questionnaire Survey

5.2.1 Summary of Questionnaire

A questionnaire survey was conducted with students who had participated in the first and second remote classroom sessions. The questions are shown in Table 1. After each session, the questionnaire was distributed to the participating students at each school. The students answered each question by choosing one prepared answer ranging from “0: not applicable at all” to “10: very applicable.” Then, in order to compare the first and second learning environments, questionnaire sheets completed by students who participated in both sessions (16 students from Nara and 15 from Kumamoto) were selected from the collected sheets to make the analysis.

5.2.2 Results

In order to find out the average value and standard deviation (S.D.) of each question, as well as to confirm the difference between the questionnaire answers from the first and second sessions, a Wilcoxon signed-rank test was conducted on each item, the result of which is shown in Table 2. According to the Wilcoxon signed-rank test result, differences were observed in Q1–Q9 at the significant level of 1%, but no significant difference manifested on Q10.
Table 1: Questionnaire and its Average, S.D.
(Wilcoxon signed-rank test results [*** indicates a significance at 1%])

<table>
<thead>
<tr>
<th>Question</th>
<th>Average 1st (SD)</th>
<th>Average 2nd (HD)</th>
<th>S.D. 1st (SD)</th>
<th>S.D. 2nd (HD)</th>
<th>V-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 I saw texts clearly</td>
<td>5.14</td>
<td>7.45</td>
<td>2.76</td>
<td>2.29</td>
<td>27***</td>
</tr>
<tr>
<td>Q2 I saw figures &amp; pictures clearly</td>
<td>4.79</td>
<td>7.83</td>
<td>2.44</td>
<td>2.12</td>
<td>7***</td>
</tr>
<tr>
<td>Q3 I saw the lecturer’s facial expression clearly</td>
<td>4.52</td>
<td>7.10</td>
<td>2.26</td>
<td>2.21</td>
<td>28***</td>
</tr>
<tr>
<td>Q4 I saw the remote student’s facial expression clearly</td>
<td>3.66</td>
<td>7.17</td>
<td>2.45</td>
<td>2.27</td>
<td>3***</td>
</tr>
<tr>
<td>Q5 I knew where the remote person was pointing with a pointer or finger.</td>
<td>6.07</td>
<td>8.52</td>
<td>2.66</td>
<td>1.84</td>
<td>16***</td>
</tr>
<tr>
<td>Q6 The video image was natural.</td>
<td>4.29</td>
<td>6.76</td>
<td>2.42</td>
<td>2.34</td>
<td>25***</td>
</tr>
<tr>
<td>Q7 Was it easy to watch the video image of remote participants?</td>
<td>4.55</td>
<td>7.48</td>
<td>2.49</td>
<td>2.31</td>
<td>10***</td>
</tr>
<tr>
<td>Q8 I could feel the mood of the remote participants.</td>
<td>4.96</td>
<td>7.76</td>
<td>2.50</td>
<td>1.84</td>
<td>27***</td>
</tr>
<tr>
<td>Q9 I felt like we were in the same room.</td>
<td>4.62</td>
<td>6.62</td>
<td>3.16</td>
<td>2.51</td>
<td>74***</td>
</tr>
<tr>
<td>Q10 The entire HM was good.</td>
<td>7.59</td>
<td>8.41</td>
<td>2.58</td>
<td>2.01</td>
<td>55</td>
</tr>
</tbody>
</table>

6. Possibilities of HM Connecting Three Locations and Comparison of Image Quality

6.1 Possibilities of HM Connecting Three Locations

The paper examines the usability of HM connecting three locations. Past trials using HM connected only two locations, but as this paper describes, distance learning connecting three different locations facilitated by HM was also proven to be successful. By using HM, the students at Nara and Kumamoto were able to experience research and learn about particle physics with experts involved and also exchange opinions with other students and experts. Furthermore, mutual communications and learning activities occurred without major problems. Because of the synthesized presentation materials in the background, participants in the three locations were able to learn by sharing the same materials. The three-location network demonstrated in this study may be useful in carrying out distance learning activities where students of two schools hold discussions with a remotely-located expert, like in the learning session introduced here, or engage with three schools located remotely from each other.

In addition, according to the opinions of the students, regardless of the picture quality, by being able to stand next to one another in the virtual shared space and shake hands gave a sense of closeness with the partner, a feeling of reality that made it easier to ask questions and learn together.

6.2 Comparison of SD and HD

With the results of the questionnaire survey conducted with the students, this paper compares HM with SD and HD. First, as to Q1–Q7 of the questionnaire referred to image quality, there was a significant difference between SD and HD. It was clarified that HD image quality was subjectively conceived as better than that of SD. Comparing the average score of the text (Q1) and the figure and picture (Q2), there was a difference between HD and SD (as to HD, Q1 [7.45], Q2 [7.83] increased by 0.38; as to SD, Q1 [5.14], Q2 [4.79] decreased by 0.35). If the average scores of Q1 and Q2 in the case of HD were similar (i.e., if there was no difference in the ease of seeing the text and figure), this seems like a plausible explanation for the difference. But in fact, the results showed the opposite. Thus, it was presumed that students had more need to see figures and pictures than text in distance learning. Applying the same logic to facial expressions of lecturers (Q3) and students (Q4), although there was no distinct difference in the case of HD (Q3 [7.1], Q4 [7.17] increased slightly by 0.07), there was a difference in the case of SD (Q3 [4.52], Q4 [3.66] decreased by 0.86). Considering this, students paid more attention to the facial expressions of remote students than of lecturers. According to Redfern and Naughton (2012), facial expressions were an important visual cue for expressing emotion, agreement and understanding in online environments. Thus, students might deepen a sense of togetherness with the counterpart and be eager for building relationships each other, rather than the experts.

Answers to Q8 on the realistic feeling of the lecture similarly showed significant differences,
which agree with the preceding study assessing image quality in distance learning. Q9 asked about the sense of being in the same room with the remote participants. The answers for this question, again, found a significant difference between SD and HD. The same-room feeling is considered to be created by the special feature of HM. The manifestation of a significant difference in the answers to the question clarified that image quality influences the students’ sense of being in the same room.

Q10 referred to the overall assessment of the HM environment. For this question, the difference between SD and HD was not significant; however, the gap between the average score was just 0.82 (Q1–Q9 of average 2.68). This fact suggests that image quality is not the sole contributing factor in the overall assessment of the HM system. Further examination is required on this matter.

7. Conclusion

In this paper, distance learning sessions with HM connecting three locations in Tsukuba, Nara, and Kumamoto were conducted with SD and HD to explore the possibility of HM connecting three locations as well as to compare SD and HD. As for HM connecting three locations, the practices with SD and HD were conducted without any problems. With HD, the image transmission bandwidth was at least 4 Mbps, and therefore, the wide and stable network was required at each location. Mutual communications and learning activities were carried out among participants as a result of multipoint HM, which made the distance learning environment close to that of a normal classroom.

According to the questionnaire, the image quality was not the sole contributing factor in the overall assessment of HM. From the result of Q10, we believe HM to be an effective system for distance learning, regardless of its picture quality. However, it was found that the participants paid attention to the graphs, pictures, and the expression of the other students. According to their free submission, the letters, pictures, and the expressions of the other person are hard to recognize with the SD image quality. Thus, in the preparation of the background image, particular attention should be paid to the size of graphs and pictures and care should be taken regarding where the participants should stand in order to maximize the quality of distance learning.

In the future, the question of what kind of educational activities are feasible or concerning videoconferences, and learning effectiveness with the image quality and further educational merits in HM connecting multiple locations shall require further study. Also, the establishment of an environment in which it is easier to set up the three-location HM is necessary. We would like to further discuss the effects of the environments described here on learning.

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Information Literacy Skills of Pre-service Teachers: A Case Study

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Abstract: This study aimed at evaluating the information literacy skills of 29 pre-service teachers. Information literacy skills include five essential areas: the ability to (1) identify the information needs; (2) select information sources; (3) locate information; (4) evaluate information; (5) synthesize information. These areas are essential life-long learning skills for pre-service teachers to cope with the rapid change in the information age. In the present research, information literacy skills were measured by questionnaire, multiple choice knowledge test and task-based information problem. The findings indicate that the majority of participants lacked information literacy skills. It is concluded that instructional support to foster pre-service teachers’ information literacy skills is essential.

Keywords: Information literacy, teacher training, information skills

1. Introduction

In the 21st century, students use Internet to retrieve and use information for solving problems or completing their assignments (Kolikant, 2009). Students should know how to search, evaluate and organize information from the Internet, which are the essential life-long learning skills and key elements of information literacy. However, there is little attention in schools. Teachers assume students can develop the skills spontaneously (Walraven, 2008). In Hong Kong, only one university offers a credit course on Information Literacy. Researches have shown that all age groups have problems in solving information-based problems (Argelagos & Pifarre, 2012; Probert, 2008; Walraven, Brand-Gruwel & Boshuizen, 2008). Teachers should help their students to develop their information literacy skills. An information literate pre-service teacher can search and use effective learning and teaching resources. They can also help their students to gain information literacy skills. When pre-service teachers lack information literacy skills, they have no confidence to educate their students (Demiralay & Karadeniz, 2010). It is important for pre-service teachers to have information literacy skills. We investigated the current status of information literacy skills of pre-service teachers in a self-financed university in Hong Kong. It examined pre-service teachers’ ability to: (1) identify the information needs; (2) select information sources from the Internet; (3) locate information from the Internet; (4) evaluate information from the Internet; and (5) synthesize information by using internet tools.

2. Review of the literature

2.1 Defining information literacy

The term information literacy was first introduced by Paul Zurkowski in 1974. It was not related to the education. The first and most widely cited definition of the information literacy in education was proposed by American Library Association (ALA):

“To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate and use effectively the needed information.” (ALA, 1989, n.p.).
Some professional organization like the Association of College and Research Libraries (ACRL), the Society of College, National and University Libraries (SCONUL), Australian New Zealand Institute for Information Literacy (ANZIIL) have developed the framework of information literacy for Higher Education. In regards to teacher training, the Education and Behavioral Science Section (EBSS) in the Association of College and Research Libraries has developed an information literacy framework for teacher education. Some frameworks were developed prior to the shocking rise of social media and online community (Mackey & Jacobson, 2011). It does not fully address the information knowledge required in this new Internet environment.

2.2 Assessment of information literacy

A number of information literacy assessment strategies have been developed based on the information literacy framework. Abdullan (2010) categorized the information literacy assessment data as perception data and evidence-based data. The perception based data are collected from the self-rated questionnaire while the evidence-based data are collected from the performance of specific tasks and tests. McCulley (2009) also pointed out the assessment approaches of information literacy. It included survey, knowledge tests and performance assessment.

Surveys measure how the respondents feel about their performance, rather than the actual performance of information literacy. It is a good method to assess the student confidence and perceptions of information literacy. OuYang (2007) developed an evaluation instrument of information problem solving skills on Internet resources for pre-service teachers. It included the developmental level and confidence level of pre-service teachers’ information problem solving skills.

Knowledge tests include a list of questions for students to answer, which measure what students know. It provides baseline information about students’ information literacy skills (McCulley, 2009). There are several standardized information literacy tests such as Tool for Real-time Assessment of Information Literacy (TRAILS) and Project Standardized Assessment of Information Literacy Skills (SAILS). In regards to teacher education, Beile (2009) developed the information literacy assessment scale for education, which is designed for teacher students. It included 22 multiple choice questions that reflect cognitive dimension of information literacy.

Performance assessments require students to integrate what they have learned, to think critically and to solve the problem (McCulley, 2009). Brand-Gruwel, Wopereis & Walraven (2009) designed an information task to the undergraduate students by using neutral topic, such as how to deal with food that is out of date. Argelagos & Pifarre (2011) developed 15 web-based information problem solving activities. It included technology, mathematics, social sciences and sciences. On each activity, some guided questions on each information literacy area were provided. For example, on the area “defining the problem”, students were required to write down the specific information that you need to solve this problem.

3. Methodology

3.1 Data collection and data analysis

The study included a group of 29 final year pre-service teachers who were studying in the first author’s institution. All participants were required to take a module “Information Technology for Teaching”. Information literacy skills were assessed by using questionnaire, multiple choice skills test and information task on the first week of this module, which provide the comprehensive assessment of information literacy.

Questionnaire is the most popular method to assess the information literacy skills (Walsh, 2009). The purpose of the questionnaire was to understand the perception on the information literacy skills of pre-service teachers. The questionnaire items were adopted by OuYang(2007) ’s instrument for measuring information problem solving skills for pre-service teachers . It consisted of 28 likert-type questions and it is mapped to the five essential abilities (identify information needs, select information sources, locate information, evaluate information and synthesize information).

The questionnaire did not really assess pre-service teachers’ actual performance. In order to check their actual performance, the researcher provided multiple choice skills test and information task
to all participants. The purpose of the multiple choice skills test was to assess the ability in selecting information sources, locating and evaluating information. It consisted of 19 multiple choice questions. The multiple choice items were revised based on Beile (2009)’s Test of Information Literacy for Education and Neely (2006)’s assessment items. Information task provided the most comprehensive measures of their actual performance. The participants required to solve specific information problem with several guided sub-questions.

4. Results and discussions

4.1 Questionnaire

We used a set of 28 items to understand the perception on the information literacy skills of pre-service teachers. The findings of the questionnaire were similar to OuYang’s (2007) results. In general, participants had confidence in using information to solve problem, but they lacked confidence in some technical issues. For example, the use of online database and the ways of managing the data. Table 1 and 2 show the lowest and highest score items on each area respectively.

Table 1: Questionnaire – low score items.

<table>
<thead>
<tr>
<th>Area</th>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the information needs</td>
<td>I am able to handle the requirements of the assignment or problem.</td>
<td>3.34</td>
<td>0.769</td>
</tr>
<tr>
<td>Select information source</td>
<td>I understand how to use online database</td>
<td>3.45</td>
<td>0.686</td>
</tr>
<tr>
<td>Locate information</td>
<td>I understand how to revise the search results</td>
<td>3.31</td>
<td>0.930</td>
</tr>
<tr>
<td>Evaluate information</td>
<td>I am able to evaluate the quality of information</td>
<td>3.24</td>
<td>0.872</td>
</tr>
<tr>
<td>Synthesize information</td>
<td>I am able to manage the data effectively</td>
<td>3.07</td>
<td>0.923</td>
</tr>
</tbody>
</table>

Table 2: Questionnaire – high score items.

<table>
<thead>
<tr>
<th>Area</th>
<th>Item</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the information needs</td>
<td>I know the required information to solve the problem</td>
<td>3.73</td>
<td>0.782</td>
</tr>
<tr>
<td>Select information source</td>
<td>I understand how to select the best information source to solve the problem</td>
<td>3.59</td>
<td>0.825</td>
</tr>
<tr>
<td>Locate information</td>
<td>I am able to use appropriate keywords on my search statement</td>
<td>3.72</td>
<td>0.649</td>
</tr>
<tr>
<td>Evaluate information</td>
<td>I am able to evaluate the reliability of data</td>
<td>3.55</td>
<td>0.948</td>
</tr>
<tr>
<td>Synthesize information</td>
<td>I am able to summarize information obtained from the Internet.</td>
<td>3.86</td>
<td>0.875</td>
</tr>
</tbody>
</table>

4.2 Multiple Choice Skills Test

We used 18 multiple choice questions to assess the ability in selecting information sources, locating and evaluating information. Table 3 shows the correct percentage of each question. According to table 3, more than half of the participants got a correct answer on six items (Q4, Q9, Q11, Q12, Q15 and Q17) only. The highest three items were “check accuracy of webpage” (82.76%), “URL meaning” (72.41%) and “Use of keywords” (65.52%). The lowest three items were “Determine the best information source” (13.79%), “Use of truncation” (17.24%) and “select appropriate operators” (20.69%). On the other hand, the correct percentages of all items on the area of selecting information source were below 50%. On the area of locating information, participants were familiar with the keywords setting but they did not know how to revise the search results. Multiple choice skills test indicated that they were lack of knowledge in using advanced search and operators. It may affect their performance on revising search results. In addition, the results showed that there was a contradiction between perception and actual skills on the item “determine best information source”. They believed that they could select the best information source on questionnaire but they could not determine the best information source on the multiple choice skills test.
Table 3: Results – Multiple Choice Skills Test.

<table>
<thead>
<tr>
<th>Area</th>
<th>Item</th>
<th>Correct %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select information</td>
<td>Q1: Use of information source (find a good journal)</td>
<td>34.48%</td>
</tr>
<tr>
<td>source</td>
<td>Q2: Use of specific journal database (topic in ERIC)</td>
<td>27.59%</td>
</tr>
<tr>
<td></td>
<td>Q3: Determine best information source (get brief information)</td>
<td>13.79%</td>
</tr>
<tr>
<td>Locate information</td>
<td>Q4: Use of keywords (best set of terms for specific question)</td>
<td>65.52%</td>
</tr>
<tr>
<td></td>
<td>Q5: Advanced search (Use of advanced search)</td>
<td>41.38%</td>
</tr>
<tr>
<td></td>
<td>Q6: Use of operator (1) (Select appropriate operators)</td>
<td>20.69%</td>
</tr>
<tr>
<td></td>
<td>Q7: Use of operator (2) (Meaning of asterisk*)</td>
<td>41.38%</td>
</tr>
<tr>
<td></td>
<td>Q8: Use of operator (3) (Use of truncation)</td>
<td>17.24%</td>
</tr>
<tr>
<td></td>
<td>Q9: Search strategy (1) (best way to find related article)</td>
<td>62.07%</td>
</tr>
<tr>
<td></td>
<td>Q10: Search strategy (2) (revised strategy to retrieve more results)</td>
<td>48.28%</td>
</tr>
<tr>
<td>Evaluation information</td>
<td>Q11: Search strategy (3) (retrieve fewer results)</td>
<td>55.17%</td>
</tr>
<tr>
<td></td>
<td>Q12: Website evaluation (1) (Evaluation criteria)</td>
<td>51.72%</td>
</tr>
<tr>
<td></td>
<td>Q13: Website evaluation (2) (Identify objective information)</td>
<td>37.93%</td>
</tr>
<tr>
<td></td>
<td>Q14: Website evaluation (3) (Identify currency information)</td>
<td>44.83%</td>
</tr>
<tr>
<td></td>
<td>Q15: Website evaluation (4) (URL meaning)</td>
<td>72.41%</td>
</tr>
<tr>
<td></td>
<td>Q16: Website evaluation (5) (Identify reliability information)</td>
<td>31.03%</td>
</tr>
<tr>
<td></td>
<td>Q17: Website evaluation (6) (check accuracy of webpage)</td>
<td>82.76%</td>
</tr>
<tr>
<td></td>
<td>Q18: Website evaluation (7) (check authority of webpage)</td>
<td>44.83%</td>
</tr>
</tbody>
</table>

4.3 Information Task

In order to understand the actual performance, we used information task in this research. We adopted Brand-Gruwel’s (2009) information problem – “How must we deal with perishability of food? Can we consume food that is out of date? Or must we rely on our senses?” and ten guided sub-questions were asked.

We analyzed the performance of the participants on all sub-questions by using rubrics. This research adopted Diller & Phelps’s (2008) categorization of the performance in information literacy. It included Emerging (1 mark - limited recognition of the skills), Developing (3 marks - demonstrate appropriate skills) and Integrating (5 marks - demonstrate full understanding of the skills). In order to improve the inter-scorer reliability, two markers were employed to mark the same script. The reliability coefficients of all items were higher than 0.85. Table 4 shows the assessment items and descriptive statistics on each item. It ranged from 1.31 to 2.07. Results indicated that participants demonstrated limited information literacy skills. Section 4.3.1 to 4.3.5 discuss the performance on each area and compare the results between information task and questionnaire.

Table 4: Information task – descriptive statistics

<table>
<thead>
<tr>
<th>Area</th>
<th>Assessment items</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the information</td>
<td>Identify information needs</td>
<td>2.00</td>
<td>0.627</td>
</tr>
<tr>
<td>needs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select information sources</td>
<td>Information source and its contribution</td>
<td>2.00</td>
<td>0.916</td>
</tr>
<tr>
<td></td>
<td>Best information source with reasons</td>
<td>1.74</td>
<td>0.545</td>
</tr>
<tr>
<td>Locate information</td>
<td>Use of keywords</td>
<td>1.90</td>
<td>0.632</td>
</tr>
<tr>
<td></td>
<td>Use of search statements</td>
<td>1.47</td>
<td>0.581</td>
</tr>
<tr>
<td>Evaluation information</td>
<td>Use of website evaluation criteria</td>
<td>1.50</td>
<td>0.641</td>
</tr>
<tr>
<td>Synthesize information</td>
<td>Use of tools to manage information</td>
<td>1.72</td>
<td>0.493</td>
</tr>
<tr>
<td></td>
<td>Ability to synthesize data</td>
<td>1.31</td>
<td>0.660</td>
</tr>
</tbody>
</table>

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4.3.1 Identify the information needs

The research found that pre-service teachers were not able to identify the information needs. Low ability pre-service teachers responded “Ingredient of food”, “food” (participant 21) whereas high ability pre-service teachers responded “We need the information of the usage of perishable food and how to identify whether the food is out-of-date or not” (participant 15). In fact, the low-ability participants were not able to solve the information problem by using this information needs. There was a contradiction between information task and questionnaire. They believed that they knew the required information to solve the problem but they could not identify the information needs.

4.3.2 Select information sources

The pre-service teachers listed a limited number of information sources. 16 participants (or 55.17%) listed “relevant websites” as information sources. Only 8 participants (or 27.59%) mentioned journal as one of the information sources.

In regards to the number of information sources that they could provide, the average number of information sources was 1.41. The majority of participants (51.7%) were able to write down one information sources only. The maximum number of information sources that they could provide was 4, only 6.9% of participants listed it.

On the assessment item “best information sources with reasons”, 24.1% of participants were not able to provide the best information sources. For those who were able to provide the best information sources, 27.59% of participants believed that the best information sources was websites (It included general websites, official website or government website) and only 17.24% of participants believed that journal provide the best information to solve problem. It matched with the questionnaire data. However, they did not provide any reasons to explain it.

4.3.3 Locate information

On the assessment item “use of keywords”, 41.38% of participants were able to write down one or two keywords only and 45% of participants were able to write down more than two keywords. However, many of them used the original wordings on the information problem. 37.93% of participants used “perishability” as one of the keywords. Only two participants (or 6.89%) were able to provide relevant keywords other than the wordings on original problem. For example, participant 15 provided a series of keywords like “food poisoning, food spoilage, bacteria, fungous spore, decay of food, food preservation”. Refer to the above results, it did not match the results on questionnaire. They believed that they were able to create appropriate keywords but they used the original words only.

On the assessment item “use of search statement”, 41.4% of participants were able to use single search statement and 31.0% of participants were able to provide more than one search statements. Similar to the assessment item “use of keywords”, they were able to provide some simple statement from the original problem. For example, participant 22 provided the statement “How to deal with perishable food?” and participant 26 provided the statement “Perishability of food”. In fact, only 4 participants (or 13.79%) were able to use search operators on the search statement.

4.3.4 Evaluate information

Over half of the participants were able to use “authority” (16 participants or 55.17%) and “currency” (15 participants or 51.73%) as website evaluation criteria. Some of them used “objectivity” (11 participants or 37.93%), “reliability” (8 participants or 27.59%) and “coverage” (5 participants or 17.24%). However, some participants used wrong evaluation criteria, like “Ranking”, “Readable”, “Easy to search” and “Common Sense”.

4.3.5 Synthesize information

The majority of participants used Microsoft Word (14 participants or 48.28%) and browser bookmarking services (12 participants or 41.38%) to manage information. It was not a good strategy to
manage information and it matched with the results on the questionnaire. They knew how to summarize
information but they were not able to manage the data effectively.

On the assessment item “Ability to synthesize data”, 31.03% of participants were able to respond to the information problem. Some participants were able to respond to each sub-question by using table or concept map, but some participants used one or two sentences to synthesize information. For example, participant 18 used “Expired food --> high germ production (from relevant biologist) --> Harmful --> Do not eat!!!”.

5. Conclusion

This paper reports the information literacy skills of pre-service teachers in the first author’s institution. By using questionnaire, multiple choice skills tests and information tasks, it investigated the perception and performance of information literacy skills of pre-service teachers. Results showed that participants had confidence in their information literacy skills but they had limited knowledge of information literacy. However, the relatively small sample size in a particular program limits the generalizability of the findings to other pre-service teachers who are studying education programmes in other institutions. Further studies can systematically investigate how to foster pre-service teachers’ information literacy skills in teacher training curriculum.

References


Interactive Whiteboards in Classrooms: Debates, Issues, and Impeding Factors

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Abstract: This paper compiles the review of the literatures revolving around the studies on the use of interactive whiteboards in schools. It criticizes and summarizes the current debates, issues, and impeding factors found in empirical studies. Through various articles related to the studies about technology and interactive whiteboard in schools dated from 1986 to 2014, the findings of this critical review suggest that teacher-centered versus student-centered mode of instruction is one of the most debated issues highlighted across studies. Unfortunately, teachers are being continuously blamed on the way they use the interactive whiteboards. The method technology is introduced to the teachers, teachers’ willingness and negative perception on technology initiatives, trainings, and technical problems, are among other issues and impeding factors that hampers the interactive whiteboards implementation in schools. This paper also identifies the gap in the literature and calls for future research in areas such as the role of context and school community involvement in the diffusion process of interactive whiteboard technology.

Keywords: interactive whiteboard technology, teacher-centered, student-centered, issues, problems

1. Background

The interactive whiteboard is deemed as the most advance technology at present. A report by the SMART Technologies Inc. suggests the benefits of the interactive whiteboards on students when used by teachers: “Educators can use digital resources while maintaining dynamic interaction with the entire class, provide computer-based learning without isolating students and encourage a higher level of student interaction in both teacher-directed and group-based exchanges.” (2006, p. 5).

As its name implies, interactive whiteboards have the affordances to be used in an interactive manner and could support interactive learning (Mildenhall, Swan, Northcote, & Marshall, 2008). Based on the literature, it is found that interactive whiteboards have been used in schools for orientating lesson, orchestrating interactive teaching-learning activities (Gillen, Littleton, Twiner, Staarman & Mercer, 2008; Coyle, Yañez & Verdú, 2010), creating and saving lesson resources (Hall & Chamblee, 2009; Littleton, Twiner & Gillen, 2010), and linking them with other technological resources (Armstrong, Barnes, & Sutherland et al., 2005). Empirical studies showed that in many ways, these aforementioned types of usage underpin teachers’ manner in integrating interactive whiteboards in their teaching.

2. Research Purpose, Questions, and Methods

The purpose of this paper is to provide evidences from empirical studies that have been carried out on the interactive whiteboards in classrooms. Because the interactive whiteboard technology have become more ubiquitous and its endowment initiatives in schools are increasing over the past decade, this paper summarizes the key issues arising from these initiatives as a means to provide insights into the implementation of such technology. The questions that drive the review of the literature are: (1) What
is/are the current trends or debate(s) in literature on the interactive whiteboard initiatives? and (2) What are the issues and impeding factors toward interactive whiteboards implementation in schools? The review of the literature involves various research studies of the related field dated from 1986 to 2014. Such collections of research studies are gathered through the researchers’ comprehensive search on articles based on the questions that motivate this study.

3. Discussion

3.1. Teacher-centered versus Student-centered Debates in Interactive Whiteboard Classrooms

The question of whether the mode of lesson delivery should be teacher-centered or student-centered has become a debated issue among scholars. With the interactive affordances of the digital whiteboard, teachers are expected to make their instructions more student-centered rather than teacher centered (Taylor, Harlow, & Forret, 2010; Kershner, Mercer, & Warwick et al., 2010; Northcote et al., 2010; Şad & Özhan; 2012). Other studies emphasize the importance of student authority in maneuvering their own learning (Kennewell, Tanner, & Beauchamp, 2008; Harlow, Cowie, & Heazlewood, 2010).

Beauchamp (2004) found in his study that most of the time, teachers retain control of the interactive whiteboards, giving little to no chance for students to explore and navigate the technology or to perform tasks on the board. Although the mode of instruction may not be student-centered, this step may result in the students being able to learn how to use the technology by observing teachers’ use. In contrary, Northcote et al. (2010) argue that too much control of interactive whiteboards by teachers does not only limited students’ opportunity to use the board, but it also leads to a teacher-controlled classroom.

Similarly, Kennewell et al. (2008) point out that the implementation of interactive whiteboards might be regarded as a backward step towards teacher-centered learning. They argue that learning is becoming more teacher-centered when teachers enforced a more traditional approach in the use of interactive whiteboards. This is consistent in both studies conducted by Kershner et al. (2010) who analyzed students’ semi-autonomous use of interactive whiteboards, and Zevenbergan and Lerman (2010) who explored the various approaches used by teachers for mathematics teaching in interactive whiteboard environment.

Miller, Glover, and Averis (2005) recommend maximizing the number of students working on the interactive whiteboards for a student-centered instruction. This can help students develop confidence in using the technology as well as influencing their peers to participate in classroom activities centered on the board. However, amidst the debates of teacher-centered versus student centered instruction, there is a gap on how much we know about teachers’ goals. Such gap lacks in addressing teachers concerns when using the interactive whiteboard, which may include their specific learning goals that must be achieved during a specific time frame. Can they possibly achieve their goals by allowing students to use interactive whiteboards in an unlimited manner hoping that students can be more participative?

A recognized pattern emerging from the literature portrays teachers as being repeatedly blamed for the manner in which they use the interactive whiteboards in classrooms. For instance, overuse of interactive whiteboards is said to promote teacher-centeredness (Northcote et al., 2010). Studies have reported that the use of interactive whiteboards has resulted in teachers becoming more active while students are becoming more passive (Holmes, 2009). Some teachers use the interactive whiteboards as a form of supported didactive role (Miller et al., 2005) hence the affordances of interactive whiteboards to support interactive teaching are often overlooked (Holmes, 2009; Northcote et al., 2010). It seems that everything that the teachers do on the use of interactive whiteboards is not seen positively.

de Koster, Volman, and Kuiper (2013) attempt to define the difference between a teacher-centered or student-centered instruction based on the person in charge of the interactive whiteboard. They claim that a lesson is teacher-centered when knowledge transmission was done by the teacher and a lesson is student-centered when content sharing occurs between teachers and students. Nevertheless, the classroom’s interactivity should not be judged based on the basis of who operates the board alone. They
also call for realistic expectations among the technology imposers and teachers when looking at how the interactive whiteboards are used in classrooms.

It is really delicate for teachers to strike a balance to juggle their several obligations and paying attention to students’ needs while at the same time thinking of creative ways to maximize the use of interactive whiteboards. The current literature points to the importance of letting students to have more control of the interactive whiteboard with the idea that this could increase their participation in classroom activities and engagement in lessons (Miller & Glover, 2002; BECTA, 2003; Kennewell et al., 2008; Wood & Ashfield, 2008; Harlow et al., 2010). However, very little is known about how this idea could be translated as a teacher-centered or student-centered instruction, and the ecological factors that foregrounds the mode of such instructions found across studies.

3.2. Issues and Impeding Factors

For every innovation that tries to make its way into a system, there exist several processes that may support or impede its use and implementation. Rogers (2003) calls this as the innovation-decision process where innovations can be rejected at any time during or after the adoption process. According to him, the innovation decision could be made either by an individual, collectively, or authoritatively by the leader of a social system. Across studies, there are evidence on how such decisions have affected the adoption process and its continuity.

Glover and Miller (2002) suggest that leadership type affects the implementation of interactive whiteboards in schools. Teachers in the schools where Glover and Miller (2002) conducted their study were not keen to integrate technology into their classrooms because they were fearful that this innovation would become just another “educational gimmick” (p. 6). However, when the faculty heads started to implement the interactive whiteboards and demonstrated ease of use, the teachers started to gain confidence in the technology. This phenomenon of a domino effect where one movement from the faculty heads had sparked movements to other teachers. The smooth implementation and use of interactive whiteboards demonstrated by the faculty heads were visible to the teachers, resulting in positive reactions.

On the contrary, in another school in the same study, the head teacher made an authoritative innovation-decision whereby he pursued a policy of forcing staff members to use the new technology. Interactive whiteboards were installed in classrooms without the teachers’ knowledge. The head teacher contended that this step would leave his teachers with no choice but to use the interactive whiteboard. Nevertheless, this approach raises issues of disadvantage, especially when teachers were not ready or willing to use the interactive whiteboard in their teaching. This may lead to the underuse of technology and is seen as a waste especially when the installation has cost a massive amount of investment (Cuban, 2001).

Cuban (1986) listed several factors that hinder teachers’ use of technology including unwillingness to change and invest time to learn that leads to teachers’ failure to recognize its affordances, unfamiliarity to technology, fear of trying new innovations, and frustration with past experiences. Teachers’ deep-seated beliefs in their current pedagogical stance, and flawed implementation, also contributed to the under-utilization of technology in schools. These are the underlying factors to the processes that impede the use of interactive whiteboards in schools.

In contrast, Northcote et al. (2010) argue that overuse of technology could lead could affect the locus of control in classroom activities, thus lead to a teacher-centered instruction. Accordingly, this leads to the impediment of teacher-student partnership during lessons and shared authority in interactive whiteboards usage. They add that such impediment diminishes the opportunity for students to interact directly with interactive whiteboards.

Training is advocated as one of the most important elements in the process of technology diffusion and implementation as a means to prepare teachers for the transition of a classroom without technology to one with an interactive whiteboard (Beauchamp, 2004). According to Miller and Glover (2002), insufficient training and limited development of interactive whiteboard teaching skills are key problems to the successful use of interactive whiteboards. Teachers also need a certain amount of time to
familiarize themselves with technology (Md. Khambari, Moses, & Wong, 2009). Moreover, a longer time is needed to prepare lessons that use interactive whiteboards.

Buckingham (2006) argues that technology should not be assumed as a neutral means for everyone. Rather, people should be educated about the technology and how to effectively use it. Therefore, training is important as it provides teachers with the appropriate knowledge before simply putting the technology in their hands and letting them decide what they could do with it. Although teachers’ training for interactive whiteboards is widely mentioned in the literature, to date, there was no mention of whether teachers are satisfactorily trained to use interactive whiteboards in an interactive manner.

Wood and Ashfield (2009) also emphasize that teachers must have control over their own lesson by choosing and deciding on the appropriate software. Now that there is an increase in the numbers of ready-made teaching resources, teachers have unconsciously become slaves to the software instead. If teachers are blindly using the commercial software and later found that the software could not help them achieve their objectives, this phenomenon may frustrates them, leads to the rejection of the interactive whiteboard (Rogers, 2003), and disregard such technology altogether from their pedagogy.

Şad and Özhan (2012) found that technical glitches such as electricity outage or de-alignment of pen, and natural distraction such as sunlight glare on the screen of the interactive whiteboard made the students upset and interrupts the use of the technology. Ju and Ya (2014) suggest that the digital feature of the interactive whiteboard offers a more hygienic classroom as compared to the dusty blackboard the teachers in their study used to use, and its ability to display multimedia has improved students’ attention, participation, and digital literacy. However, they found that the touch sensitive feature was a limitation because it only allows one user to use it at a time.

Beauchamp’s (2004) study found that student teachers predominantly perceive interactive whiteboards as an important feature of their future teaching. Experienced teachers, however, needed more convincing before they are ready to use it. Similarly, Cuthell (2005) laments that the number of schools that have changed their praxis is very small. In many cases, when a new policy is being formulated, teachers who are the implementers at the grass root level are seldom consulted. What can be learned from these studies is that a needs analysis is needed prior to the diffusion of an innovation. As such, before innovations are to be permanently placed in the classroom, information needs to be gathered on whether or not teachers prefer to have the interactive whiteboards in their classroom.

When interactive whiteboards are put into implementation in schools, teachers are expected to use the technology in their teaching. Zevenbergan and Lerman (2008) found that teachers fear of not fulfilling their professional responsibilities if they did not use the interactive whiteboards in teaching. This example provides evidence where teachers are caught in the middle between their personal pedagogy that they have been comfortable with, and the professional responsibility to keep themselves and students in tap with the latest advancements in education. Having to make a delicate decision of whether to use or not to use the technology is an issue yet to be explored in future studies.

4. Concluding Remarks

The literature to date converges on the advantages of interactive whiteboards as a tool that opens up various possibilities and teaching pedagogies. Unfortunately, there are also emerging trends of teacher blaming whereby they are criticized for the manner in which they use interactive whiteboards in classrooms. However, there is no clear definition of how an instruction with the interactive whiteboard should be regarded as student-centered or teacher-centered. Additionally, nothing about the amount of control of the interactive whiteboard by the teachers and students are discussed in the literature to clearly define the mode of instruction. Among the key issues identified in the literature highlight the importance of teachers’ readiness to integrate the interactive whiteboard technology in their classroom, as well as education authority’s role in diffusing new innovation to teachers. Conflict of interests between teachers (on their pedagogy) and technology imposers (on how they visualize teachers to use the interactive whiteboards) could lead to the underuse of the technology. Perhaps the teacher-centered or student-
centered debates, and teacher blaming issues, do not even make sense if areas such as teachers’ interest and pedagogy as well as their nature of work, are explored and understood.

Rogers (2003) has warned, “many aspects of diffusion cannot be explained by just individual behavior” (p. 23). He says, among others, that the overall system should be studied to draw its several influences on its members. Based on his piece of advice, it became more evident that the literature on the interactive whiteboard use in schools lags behind in a number of areas. For instance, the nature of the school system such as its administrative system, its social, cultural, and historical practices, its climate and rules; the perceived attributes of the interactive whiteboard, and the type of the community the interactive whiteboard is diffused to, are the areas that are still remain barely touched in the literature. Additionally, nothing about the function of the school was mentioned in the literature on technology in the education system. This paper calls for future studies to take on the quantitative or qualitative nature of research to explore with more depth on the context and the social system in which interactive whiteboards are situated.

References


Learning Design Framework for Constructive Strategic Alignment with Visualizations

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Abstract: Prior research on integrating computer-based visualization tool in teaching has shown that the use of constructivist strategies has led to positive learning outcome. Yet multiple surveys report that instructors face difficulty in integrating visualizations in their teaching. A probable cause is that instructors, on their own, are unable to achieve effective alignment between the instructional strategy used with visualization and their instructional objective. Currently no guidelines exist for instructors for attaining such alignment while teaching with technological tools like visualizations. To address this problem, we propose the Customized Visualization Integration (CVI) framework based on outcomes-based teaching approach that targets ‘constructive strategic alignment’ i.e. alignment between student-centered instructional strategies and instructional objectives with the visualization. CVI provides instructors with ‘easy-to-use’ guidelines that can be combined to create learning designs (LDs) customized to their set of instructional objectives with visualization. Furthermore, it provides LDs customized to individual objectives based on these guidelines. In current paper, we also present empirical validation for a subset of the proposed guidelines through a field experiment with 144 engineering under-graduates.

Keywords: Framework, visualization, constructive strategic alignment, learning design.

1. Introduction

Computer-based visualizations involve “the use of computer supported, interactive, visual representations of data to amplify cognition” (Tory & Moller, 2004) like educational animations and simulations. These visualizations improve conceptual and procedural understanding and develop reasoning and prediction skills (Rutten et.al, 2012). However, their learning effectiveness is dependent on the instructional method used (Bratina et.al, 2002). Empirical studies show that use of constructivist strategies with visualizations like think-pair-share (McConnell, 1996) leads to improved learning outcome. Another important criterion is alignment between the strategy used and the instructional objectives (Boyle, 2012). There are several studies (Biggs, 1999; Cohen, 1987) emphasizing the importance of strategic alignment in teaching. Cohen (1987) cites multiple empirical studies that show significantly reduced learning outcome due to non-alignment between instructional strategy and objective. Thus, effective integration of visualization in teaching entails use of constructivist strategies aligned with the instructional objective i.e. constructive strategic alignment. But multiple surveys (Shaffer et.al, 2011) reveal that instructors face difficulty in integrating visualizations in their teaching. This difficulty occurs along two fronts – designing for constructive strategic alignment on their own (Conole et.al, 2004) and ensuring implementation fidelity for constructivist strategies (Ebert-May et.al, 2011). The existing solutions like learning designs (LDs) and learning taxonomies do not provide instructors with detailed guidelines on how to achieve this alignment with visualization. In fact, there is no prior study identifying instructional objectives with visualizations. Thus, a learning design framework with ‘easy-to-use’ guidelines for instructors to achieve strategic alignment for different objectives with visualization is needed. CVI (Customized Visualization Integration) is such a learning
design framework that provides instructors with guidelines and LDs to achieve strategic alignment with visualization. The contribution of this paper is the CVI framework and its three major components - i) Instructional objectives with visualization identified through an exploratory study with Science and Engineering instructors, ii) ‘Easy-to-use’ guidelines that instructors can use to create LDs aligned to objectives. iii) LDs mapped to individual objectives with visualization. We also validate the guidelines for four types of objectives with visualization, encompassing problem-solving and conceptual understanding through a controlled field experiment with 144 Electrical Engineering students.

2. Related Work

Multiple empirical studies report the benefits of using constructivist strategies with visualizations like think-pair-share (McConnell, 1996) across different instructional settings like lecture, laboratory and self-learning. But, instructors face problems in attaining constructive alignment with visualizations and maintaining implementation fidelity for the constructivist strategies. In this section we discuss a subset of learning taxonomies like Bloom’s, SOLO taxonomy, Component Display Theory and Morrison’s Extended Content Performance matrix among the many that exist. These taxonomies do not address strategic alignment for teaching with a technological tool like visualization. For example, Revised Bloom’s taxonomy provides six cognitive levels of learning objectives to guide alignment between strategy and objective. In the ‘Component Display Theory’ (Merrill, 1983) instructors can choose strategy for a complete lesson based on three major factors – i) content type (Facts, Concepts, Procedures, Principles) and performance objectives expected from students (Remember, Use, Find) ii) type of primary and associated secondary presentation forms and iii) rules relating presentation forms to content performance matrix. Morrison et. al. (2010) also bases their work on a content-performance matrix where performance objective is restricted to Recall and Application and instructional strategies to four categories – Elaboration, Organizational, Integrative and Recall. However, none of these focus on teaching with visualization nor do they provide detailed implementation plan to instructors. The other problem of implementation fidelity refers to how well the strategy execution follows the defined procedure. Empirical studies (Ebert-May et.al, 2011) have found that majority of the faculty, who professed using constructivist strategies, in fact veered towards teacher-centered teaching in their lectures. To address this problem, learning designs (LDs) provide stepwise implementation plan to instructors. They help instructors execute pedagogically sound instructional activities mapped for different types of media and instructional setting (Mor & Brock, 2012). But they do not map instructional activities to specific instructional objectives with visualization. Thus, no guidelines currently exist for instructors on achieving constructive strategic alignment with visualization.

3. Solution Approach & Research Questions

The objective of the current study was to build the CVI framework to assist instructors in effectively integrating visualizations in their teaching. This framework takes as its input the instructor’s choice of instructional objectives with visualization. It then identifies instructional strategy design components aligned to the chosen objectives. The term ‘instructional strategy design components’ refers to functional units within the strategy like raising cognitive conflict or students verbalizing their problem solving strategy. CVI outputs guidelines to achieve strategic with visualization as also LDs, mapped to particular objectives that specify stepwise execution plan to achieve the alignment.

   The three research questions explored in the study were:
   • RQ1: What categories of instructional objectives do instructors have while teaching with visualization? (Section 4.1)
   • RQ2: What are the instructional strategy design components necessary to achieve alignment with each of the identified objectives with visualization? (Section 4.2)
   • RQ3: What is the ecological validity of the mapping proposed by CVI framework between instructional objectives with visualization and instruction strategy used, for a chosen subset of objectives? (Section 5)
4. Formulating CVI (Customized Visualization Integration) Framework

The CVI framework was built in two consecutive phases with each phase having its own separate methodology. In phase 1, we identified instructional objectives with visualization through an exploratory study of semi-structured instructor interviews. In phase 2, we mapped these objectives with instructional strategy design components through analysis and synthesis of literature.

4.1 Identifying Instructional Objectives with visualization

We did a qualitative study by conducting semi-structured interviews with 61 instructors from multiple domains of science and engineering like Chemistry, Physics, Computer Science, Electrical. The instructors had teaching experience of 5-20 years and had used visualization in teaching. During the interviews, which ranged from 50-60 minutes, instructors were asked to show sample visualizations they had used and what their instructional objective was with that visualization. The interview responses were coded by two researchers through the open and axial coding stages (Corbin & Strauss, 2008) with an inter-rater agreement of unweighted Kappa 0.81. The interviews were interleaved with the open coding phase. Hence, questions asked in subsequent interviews were influenced by the open codes emerging from analysis of previous interviews. The open codes thus obtained for all the interviews were grouped into broader categories in the axial coding phase (Table 1). A total of 11 objective categories emerged which were of finer granularity than those proposed in existing learning taxonomies. In this paper we report a subset of four such objectives that were part of our validation experiment (Table 4).

Table 1: Sample coding of instructional objectives with visualization.

<table>
<thead>
<tr>
<th>Interview response (verbatim)</th>
<th>Open Code</th>
<th>Axial Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe the phenomenon &amp; construct an explanation of conductor properties &amp; fields</td>
<td>Frame the definition of a concept after observing the visualization</td>
<td>Derive, through logical reasoning, definition of a concept/relationship between variables or algorithm of a process from observations made from the visualization</td>
</tr>
<tr>
<td>Observe the visualization on sorted linked list &amp; write a simple algorithm for it</td>
<td>Develop the logic of process execution with given input parameters &amp; specified output, after observing visual demonstration of the process</td>
<td></td>
</tr>
<tr>
<td>Observe the Brayton cycle visualization &amp; draw the temperature-entropy diagram</td>
<td>Predict relationship between different variables while watching the visualization, before the concept is taught</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Identifying Instructional Strategy Design Components

In phase 2, the instructional objectives obtained were analyzed for their cognitive rigor and specific skills targeted, if any, like multiple representation or problem solving. We determined the cognitive rigor from the Cognitive Rigor (CR) matrix (Hess et.al, 2009) comprising of Bloom’s cognitive level and Webb’s depth of knowledge. We then analyzed and synthesized relevant literature to identify instructional strategy design components mapped to the objective categories. For example, for the objective of ‘Write/Draw alternate representations from the given visualization or vice-versa.’, we analyzed literature on teaching and learning of multiple representations as well as application of conceptual knowledge to identify design components relevant for the objective (Table 2). Based on this mapping, we framed guidelines for instructors on what design components to include in their learning designs to achieve strategic alignment (Table 2). We also created sample learning designs (LDs), mapped to individual objectives, that give stepwise implementation plan for attaining constructive strategic alignment (Fig. 1). We found the required design components for a particular objective can be operationalized through multiple constructivist strategies. Hence, CVI has taken a sample set of constructivist strategies like TPS-V (Think-Pair-Share with Visualization) to illustrate the execution of the recommended mappings (Fig. 1).
5. Validating CVI Framework

To validate the CVI framework, we conducted a two-group controlled field experiment in a tutorial class on the topic of ‘Signal Transformation’ in ‘Signals and Systems’ (Electrical Engineering). The experimental group (N= 70) performed a 30 minute instructional activity designed as per CVI guidelines for four objectives (Table 3) that formed the core of problem solving for the chosen topic. The control group (N= 74) activity was of same duration but was not based on CVI guidelines for three of the objectives (Table 4). The CVI guideline for the fourth objective, involving problem solving with a single process, was the control group activity of watching the visualization with instructor commentary. This guideline was included for validation since we wanted to verify that a non-constructivist activity was sufficient if the objective was at simple recall/reproduction level. Student interaction with visualization for both the groups was mediated through the instructor. After the visualization activity, both groups solved the same post-test questions for 30 minutes. The post-test

Table 2: Sample Instructional Strategy Design Components mapped to objectives with visualization.

<table>
<thead>
<tr>
<th>Instructional Objective with Visualization</th>
<th>Necessary Instructional Strategy Design Components</th>
<th>Guidelines for strategic alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Write/Draw alternate representations from the given representation in the visualization or vice-versa.</td>
<td>i) ‘Dynamically link the multiple representations. (Der Meij &amp; De Jong, 2006) ii) Make students actively integrate visualizations themselves (Ainsworth, 2006) iii) Show integration of representations (Ainsworth, 2006)</td>
<td>Design a group activity where the instructor will: i) Give a focus question, for each aspect of the information that requires students to vary parameters in one representation and simultaneously reflect on the change in the other representation (for e.g. graph and equation). ii) Follow up with an activity that asks students to integrate all the aspects into a whole (for e.g. for signal transformation, represent each transformation type individually &amp; then integrate) iv) Play the visualization that does all of the above steps to provide feedback.</td>
</tr>
</tbody>
</table>

Figure 1: Sample Learning Design mapped to ‘Multiple Process’ objective
results of the two groups were compared through non-parametric Mann-Whitney U test since the test scores showed non-normal distribution. The experimental group did statistically significantly better than the control group for the three objectives where CVI guidelines were followed by the experimental group activity (Table 4). For the fourth objective of problem solving with a single process, both groups performed equally well as expected. These results validated the CVI guidelines.

<table>
<thead>
<tr>
<th>Instructional Objective with Visualization</th>
<th>Experimental group activity derived from CVI guidelines</th>
</tr>
</thead>
</table>
| Write/Draw alternate representations from the given representation in the visualization or vice-versa. | • **Think Phase** (5 minutes) [Individual activity]  
  a) Identify what transformation operations are happening in given equation.  
  b) Draw & write down mathematical expression for the first transformation  
• **Pair Phase** (10 minutes) [Collaborative activity]  
  a) Discuss and draw stepwise the final transformed signal with the mathematical expression for each step.  
• **Share Phase** (15 minutes) [Feedback]  
  a) Compare your answer with the solution shown by the visualization |

<p>| Table 4: Mann-Whitney U test results for post-test. |
|------------------------------------------|------------------------------------------------------|</p>
<table>
<thead>
<tr>
<th>Instructional Objectives</th>
<th>Experimental group: activity based on CVI guidelines?</th>
<th>Control group: activity based on CVI guidelines?</th>
<th>Experimental Group Mean (SD) [Total Marks]</th>
<th>Control Group Mean (SD)</th>
<th>Significant difference?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Visualize to explain a specified concept</td>
<td>✓</td>
<td>X</td>
<td>2.86 (0.43) [3 marks]</td>
<td>2.42 (0.84)</td>
<td>Yes (U=1853 p= 0.00)</td>
</tr>
<tr>
<td>2. Use a given visualization to solve the given problem by executing multiple processes</td>
<td>✓</td>
<td>X</td>
<td>4.36 (1.18) [5 marks]</td>
<td>3.47 (1.71)</td>
<td>Yes (U=1883 p=0.001)</td>
</tr>
<tr>
<td>3. Write/Draw alternate representations from the given visualization or vice-versa.</td>
<td>✓</td>
<td>X</td>
<td>2.56 (0.77) [3 marks]</td>
<td>1.86 (1.15)</td>
<td>Yes (U= 1744 p= 0.00)</td>
</tr>
<tr>
<td>4. Use a given visualization to solve the given problem by executing single process</td>
<td>✓</td>
<td>✓ [CVI guideline of watching with instructor commentary met]</td>
<td>3.34 (1.34) [4 marks]</td>
<td>3.51 (1.29)</td>
<td>No (U= 2416 p= 0.5)</td>
</tr>
</tbody>
</table>

6. Discussion & Conclusion

In this section we summarize the results corresponding to each research question. We then discuss the implications of the study, its limitations and scope for future research. The first research question was answered through a qualitative study covering multiple domains and a range of visualizations. Eleven categories of instructional objectives with visualizations were identified across different instructional settings. The second research question was answered by analysis and synthesis of literature. A set of instructional strategy design components, mapped to individual objectives, were identified to achieve strategic alignment. Based on this mapping, we framed guidelines for instructors to design learning activities aligned to their objectives with visualization (Table 2). CVI also offers learning designs (LDs) mapped to particular objectives. These LDs operationalize the recommended design components through a sample set of constructivist strategies (Fig. 1). The third research question was answered through a 2-group post-test only field experiment. We measured successful constructive strategic
alignment through significantly better post-test scores of the experimental group which followed CVI guidelines compared to the control, for each of the objectives (Table 2). Though visualization selection is an important first step, in this paper we have focused on integration of visualization in teaching.

The contributions of the CVI framework are outlined below. The CVI guidelines and learning designs empower instructors to create theory-informed learning designs integrating visualizations and aligned with their set of instructional objectives. Thus CVI enables instructors to overcome the problem of how to effectively integrate visualization in teaching. There are, however, certain limitations to the CVI in its current form. Our sample base for identifying objectives was restricted to K-16 science and engineering instructors. The objectives included in CVI may not be exhaustive for non-science domains and K-12 instructors. Also, the objective identified may be a function of the cultural context of the study i.e. urban Indian classrooms. In such classrooms students do not have individual access to laptops within the class although they are otherwise technology savvy. Another limitation is that validation of CVI guidelines has been done in one topic and in one domain. As part of future work, the current validation experiment can be extended to include different ‘Signals and Systems’ topics together with topics from other domains and cover the remaining CVI guidelines. The usefulness and usability of the CVI guidelines and LDs also need to be tested with instructors. Overall, the CVI framework aims to plug the existing gap in integration of visualizations in teaching by identifying instructional objectives with visualization, providing guidelines for constructivist strategic alignment and presenting learning designs mapped to individual objectives to ensure implementation fidelity of the mapping.

Acknowledgement

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References

Practice of the Programming Education
Using Arduino and the Class Support System

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Abstract: A school setting course "Introduction to Arduino" in my school is characterized by Cross-Curriculum and Problem Solving learning on information science, physics, and mathematics, and by Flip Teaching using cloud servers. The author constructed a class support system to carry out this course and was able to develop students’ originality in a short time by utilizing the system.

Keywords: Physical Computing, Arduino, Programming, Flip Teaching, Cross Curriculum, Problem solving, 3G Shield (3rd Generation)

1. Introduction

The school setting course "Introduction to Arduino" is intended to bring up students' originality by creating their ingenious works (devices) using microcomputers which are designed to achieve physical computing easily, such as Arduino. This course incorporates cross-curriculum and problem-solving learning. This course also incorporates "flip teaching "and achieved the educational effect intended. Namely, teachers upload the teaching contents on cloud servers and students study them at home beforehand. At school, students conduct various activities in order to create their own works. We also constructed a class support system to conduct flip teaching, and could produce favorable results in a short time.

2. Programming education Arduino in Koishikawa

2.1 Characteristics of the programming education using Arduino

In Koishikawa, programming education using Arduino has been performed in the school setting course "Introduction to Arduino", in club activities after school, and in open laboratories.

In order to perform activities for creating original works using Arduino, it is necessary for students to have cross-curriculum problem solving ability. It is made up of programming technology (Information Science) as a core component, and of sensor technology (physics), formula manipulation (mathematics), and so on. To develop those abilities is a purpose of this course, and it allows students to experience “cross-curriculum problem solving learning”.

This course has only two hours a week, and it is difficult to achieve the purpose by doing the traditional style of teaching for the whole class.

As a result, I started “flip teaching "using cloud servers. Students watch teaching materials which a teacher uploaded on the cloud servers such as a video sharing site (YouTube) or on the online storage (OneDrive) at home as preparations for lessons. At school, the teacher can give the individual instructions to the students. In addition, students can perform activities to create their works while cooperating with each other based on the knowledge that they got from the preparations. In this way, it was available to bring up students’ originality, instead of conducting knowledge transmission-centered classes.
2.2 Class recording system for programming education

In the school setting course "Introduction to Arduino", I recorded the video materials with the class recording system which I devised, and uploaded it in the video sharing site. Students watched them as preparations for lessons at home, etc., and they conducted activities at school for solving problems and creating devices based on the knowledge that they had learned.

It is desirable to install the encoder (Microsoft Expression Encoder) in the console machine (shown in Figure 1). The author also used a capture box to connect the teacher’s machine and the console machine. It connects the audio output of the teacher’s machine to the audio input of the console machine. It also captures the video signals on the screen of the teacher’s machine and sends them to the USB terminal of the console machine. The encoder in the console machine encodes data from the USB terminal and generates the movie file of the WMV form. If the destination to save the video file is set to the server machine, load of the console machine decreases.

Figure 1. Class recording system (Bold line parts are added)

Figure 2 is an example of the desktop screen. Teaching materials to be used in the school setting subject “introduction to Arduino” are recorded on the desktop.

In the screen of Figure 2, a supersonic wave range sensor is attached to Arduino. It shows the example of structure and the program of measuring distance. In the top right corner, a picture of Arduino is displayed. A supersonic wave range sensor is attached to it using overhead camera. In the lower right corner, an explanatory figure is displayed with PowerPoint. It explains the structure about how the supersonic wave range sensor measures distance.

In the left, Arduino IDE (Integrated Development Environment) is displayed. The program to measure distance is shown in it.

To use these systems makes it possible to prepare teaching materials that include a picture from overhead camera, PowerPoint, other software, and the sound from a microphone at the same time and in real time, like a DVD recorder.

The recorded videos are uploaded to the video sharing site of Google (YouTube). YouTube has a limited disclosure option without opening to the public in the world. It is enabled by telling a URL of the uploaded videos to only authorized persons. The author uploaded files which I recorded through the system mentioned above, and opened it only to the students who took my course.

The author also uploaded the corresponding files except the video files to an online storage OneDrive (former name SkyDrive) by Microsoft.

The students can watch videos to prepare for lessons using these files at home.

At school, based on the knowledge that they got from the preparations for lessons, they performed activities for the problem solving and the creating something that each student set as a goal.
2.3 Contents of the School Setting Course "Introduction to Arduino"

2.3.1 Annual instruction plan

This year’s annual instruction plan for this course (2 hours a week) is as follows. Particularly, the content of the learning in the first half of the first term at home is to acquire basic knowledge to handle Arduino. It will take around one year to acquire them in the form of the conventional mass teaching. However, by studying in advance at home using the cloud environment, students can finish within the period

(1) The first half of the first term (from Early April to Last May)
   • At home (prior learning in the cloud environment)
     Students learn about functions of Arduino, how to use it, analog and digital, digital input, digital output, analog input, analog output, binary numbers, programming (variable, substitution, input and output, sequential, divergence, repetition, function, etc.) and various sensors. (temperature, light, infrared proximity, supersonic wave, etc.)
   • At School (creative activities by each student)
     Students perform operation confirmation experiments on sample programs using Arduino.

(2) The latter half of the first term (from Early June to Mid-July)
   • At home (prior learning in the cloud environment)
     Students research various works of Arduino on the Internet based on knowledge and the experience they got in the first half of the first term. In reference to them, each student devises an original work (including the summer vacation).
   • At School (creative activities by each student)
     Students perform inspection experiments with Arduino and various sensors to confirm the feasibility of the works they devised.

(3) The first half of the second term (from Early September to Mid-October)
   • At home (prior learning in the cloud environment)
     Students think about algorithm to move their original devices on Arduino and upload document files to a cloud server.
   • At School (creative activities by each student)
     Students attach various sensors to Arduino and produce physical devices.
     Students perform operation checks using Arduino at home referring to the document files they uploaded in which they wrote down the algorithm.

(4) The latter half of the second term (from Late October to Mid-December)
   • At home (prior learning in the cloud environment)
     Students make materials (documents and files for presentation) to apply for contests, and upload them to a cloud server.
   • At School (creative activities by each student)
     Students practice presentation in front of other students to prepare for contests using the file which they uploaded.
     Students complete their works at the same time. Participation in contests (Late November)

(5) The third term (from Mid-January to Mid-March)
   • At home (prior learning in the cloud environment)
     Students prepare for school presentation, make articles, and upload them to a cloud server.
   • At School (creative activities by each student)
     Students practice presentation in front of other students using the file which they uploaded.
   • School presentation and paper submission (Mid-March)
2.3.2 **Examples of Cross-Curriculum Teaching Materials for "Introduction to Arduino"

The teaching materials which the author made for home learning are made up of videos and presentation files for explanation. These are uploaded on cloud servers such as YouTube or OneDrive, and are the teaching materials to develop students’ cross-curriculum ability among information science, physics, and mathematics. Figure 3 is a part of them. It shows the way to treat a temperature sensor in Arduino (shown in Figure 4).

We can see that "analog and digital" and "programming" are related to the subject "information science", "temperature" and "voltage" are related to the subject "physics", "primary function" is related to "mathematics" from the teaching material above.

Thus, it is possible to develop students’ cross-curriculum ability by using Arduino.

Let the analog input voltage of the AD converter stand for V, and the digital value corresponding to it stand for D, and it equals to expression (1) in the 10-bit AD converter, where D=0–1023(integer value), V=0–5

\[ V = \frac{5D}{1023} \quad (1) \]

The output voltage of the temperature sensor is 0.6[V] in the case of 0[°C]. It changes 0.01[V] with respect to the temperature change of 1 [°C]. They are shown in a graph on the lower right hand side. The output voltage \( V_{out} \) in case of \( t \) [°C] is as follows.

\[ V_{out} = 0.01 t + 0.6 \quad (2) \]

The output voltage \( V_{out} \) of the temperature sensor equals to the input voltage of the AD converter, therefore \( V \) in the expression (1) equals to \( V_{out} \) as in expression (3).

\[ V_{out} = \frac{5D}{1023} \quad (3) \]

From expression (2), expression (3),

\[ t = 100V_{out} - 60 = \frac{500D}{1023} - 60 \quad (4) \]

The program in Arduino, expression (4) is as follows.

```c
int value = analogRead(A0); // analog input
//convert to temperature
float temperature = 500*(float)value/1023 - 60;
```

Figure 3. The example of the teaching material which includes cross-curriculum contents.

Figure 4. Connection of the temperature sensor and indicating temperature to the serial monitor.
2.4 The example of a student’s work

A student participated in the open laboratory (open study) last year, and the work that the student devised won the Excellence Award in a contest (3G shield idea contest). The summary of the student’s work is as follows. This is a work which was made in combination with Arduino and 3G Shield (Figure 5 – Figure 6). 3G Shield is an expansion board for the 3rd generation mobile communication network intended for cellular phones and smart phones.

![Figure 5. Schematic diagram of a pet management system (student’s work)](image)

The work title is “Pet management system”. The purpose is to know the pet behaviors even if the owner of the pet is away with Arduino and a 3G shield.

Arduino is combined with 3G shield. It enables the pet owners to grasp the approximate behaviors of the pet by connecting an infrared proximity sensor and installing it on the dish, bed, restroom, etc. downward. An email will be transmitted to a cell-phone or a smartphone when the pet gets closer to an infrared proximity sensor. It can also be applied to the simplified home security as well.

![Figure 6. Pet management system (student’s work)](image)

3. Evaluation and Analysis

The author conducted a survey in the form of a questionnaire at school setting course "Introduction to Arduino".

Table 1. Questionnaire (N=15)

<table>
<thead>
<tr>
<th>Question</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question1</td>
<td>0(0.0%)</td>
<td>0(0.0%)</td>
<td>4(26.7%)</td>
<td>5(33.3%)</td>
<td>6(40.0%)</td>
<td>4.13</td>
<td>0.81</td>
</tr>
<tr>
<td>Question2</td>
<td>0(0.0%)</td>
<td>1(6.7%)</td>
<td>4(26.7%)</td>
<td>7(46.7%)</td>
<td>3(20.0%)</td>
<td>3.80</td>
<td>0.83</td>
</tr>
<tr>
<td>Question3</td>
<td>0(0.0%)</td>
<td>2(13.3%)</td>
<td>3(20.0%)</td>
<td>6(40.0%)</td>
<td>4(26.7%)</td>
<td>3.80</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Based on a 5-point Likert scale: 1 = very low, 2 = low, 3 = normal, 4 = high, 5 = very high
Question 1. Were the teaching materials uploaded in YouTube and One Drive easy to understand?
Question 2. In order to build a new system using Arduino and sensors, you had to introduce problem-solving learning, combining the knowledge of various subjects such as information, physics, and mathematics together. Were you able to understand such a technique?
Question 3. This course employs flip teaching. In flip teaching, you will watch videos at your house to prepare for the lesson, and address various tasks without listening to explanations in the lesson. Were you able to keep up with the flip teaching?

The ratio of the affirmative response to the question 1 was about 73%.
The reason for the positive responses is considered that students could learn repeatedly because the teaching materials were given by video format.

The ratio of the affirmative response to the question 2 was about 67%.
In the lesson using Arduino, students need not only the knowledge of programming, but also the problem-solving learning in which students combine the knowledge of sensor technology and formula manipulation, and so forth. Considering the responses, students were able to feel the novelty and fun in the lessons which many conventional subjects do not have. The student who made a negative response might feel a sense of incongruity in the difference from the conventional classes.

The ratio of the affirmative response to the question 3 was also about 67%. On the other hand, there were about 13% of negative responses. The standard deviation was the biggest in three questions. In order to watch videos before a lesson, decent efforts and active engagements of the students are required. Since this course was an optional, many students were already motivated and that led to the sufficient result. However, two students were not able to achieve the purpose.

4. Conclusion

(1) There are such effects by using Arduino and various kinds of shields that students can easily learn the most advanced, leading-edge technologies in a short time, and students can expand the creativity.
(2) The view may be becoming a thing of the past that each subject cultivates students' abilities and those will work as a basis when students get out into the world. The abilities which are useful in the society will be promoted better through cross-curriculum learning. The programming lessons using Arduino enables students to foster cross-curricular and problem-solving abilities effectively.
(3) The merits of the flip teaching: for the students who are eager and motivated, their academic abilities will be all the more increased because they can learn repeatedly. For the students who are not eager and motivated, they can learn repeatedly watching videos again and again, and the videos can be used as reviews, students' time for study at home will increase, and so forth. The demerits of the flip teaching: to correspond to the students who will not prepare the lesson. However, that should not be regarded as a demerit because it is not limited to the flip teaching.

References


Predicting the Perceived Usefulness of eBook among Mathematics Teachers

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Abstract: The introducing of the one-to-one eBook for each students were said to be an important move to encourage technology integration in mathematics classrooms. This study sets out to examine the perceived usefulness of the eBook among Mathematics teachers, where the affects of four predictors, namely the critical mass, learning opportunities, facilitating conditions and personal innovativeness were assessed. Using validated questionnaires, a survey was conducted involving 304 mathematics teachers. Structural Equation Modeling (SEM) was used to analyse the data obtained. The result showed that 62.6% of variance of perceived usefulness was explained by the four exogenous variables. Critical mass, learning opportunities and facilitating conditions were found to significantly affecting perceived usefulness while the personal innovativeness did not.

Keywords: eBook, Mathematics teachers, perceived usefulness, critical mass, learning opportunities, facilitating condition, personal innovativeness

1. Introduction

The effort to integrate technology into mathematics teaching and learning depends firmly on the teachers’ perception on its usefulness. Assuming that, teachers who do not believe that technology utilization will fulfill their needs and also their students’, would most probably avoid using technology in their lessons (Teo, 2012). One predictor factor that was found to strongly predict the teachers’ attitude towards using technology is the perceived usefulness. The attitude, which is either positive or negative, will in turn influence the behavioral intention to use a specific technology.

Many experts in educational technology believed and agreed that technology use in school could not reach the maximum effectiveness until the computer is no longer shared (Bebell & Kay, 2010). Since a decade ago, a new educational transformation has emerged when more than 40 countries across the world have provided laptops to teachers and students without sharing (Mo et al., 2013). In Malaysia, the state Terengganu was among the first to introduce this concept of one-to-one laptops in 2009 in the vision to produce techno-savvy citizen (Wan Muhammad Amir et al., 2013). The eBook provided in the initiative is a low-cost netbook computer or a mini laptop, able to connect to the Internet and also installed with the digital textbook softwares. Students nowadays, dubbed as the generation Y preferred a flexible learning environment, yet not replacing the traditional teaching but enhancing the students’ learning experience(Jazihan, Ahmad Fauzi, & Wong, 2012)

Despite the large amount of money spent, the use of computers by teachers in classrooms remains minimal and inefficient (Ministry of Education, 2013; Teo, 2009). In addition, students and parents reported that the time spent by mathematics teachers using laptops in the classrooms is half the time spent using laptops for other subjects such as Science and English (Zuber & Anderson, 2012). Numerous studies on one-to-one laptop consistently reported that utilization in mathematics classroom has the lowest rate compared to other subjects without elaboration of the reasons (Bebell & Kay, 2010).

Hence, this study is based on the Technology Acceptance Model (TAM) which rooted from Theory of Reasoned Action (Fishbein & Ajzen, 1975) that posits that users’ technology acceptance is determined by their perceptions on the usefulness and the ease of use of technology (Davis, Bagozzi, & Warshaw,
The model was designed to explain and predict users’ acceptance on any types of technology and have been widely tested in series of empirical studies for validity. Recent educational research using TAM in Malaysia include studies by Jazihan, Ahmad Fauzi, & Wong (2013) and Ariff, Yeow, Zakuan, Jusoh, & Bahari (2012). In the recent study, perceived usefulness is highlighted as it is the core determinant of behavioral intention in TAM, which is the main factor that may affect the use of a technology (Davis et al., 1989). Perceived usefulness could possibly be affected by numerous external variables depending on the needs and research area (Davis et al., 1989). In this study, four external variables were carefully selected based on literatures and research needs namely the critical mass, learning opportunities, facilitating condition and personal innovativeness.

A person will use a certain technology if it is useful in helping him/her perform better in his job (Davis, 1989). In the context of education, perceived usefulness can also be seen in the students’ test performance. Scales were refined and developed by Davis (1989) and defined explicitly as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). An important social factor identified on adoption and acceptance of technologies is the perceived critical mass. The adoption and communication media use were then explained in the critical mass theory where a technology value boost exponentially to the total number of the users (Lou, Luo, & Strong, 2000). In the context of technology adoption, Bourgonjon et al., (2013) describes critical mass as the idea that a technology’s utilization rate is slow until a certain number of users have used and accepted the technology. Learning opportunities, however is the learning process and the opportunities given in the process, defined as ‘the degree to which a person believes that using a particular system can offer him or her opportunities for learning’ (Bourgonjon, Valcke, Soetaert, & Schellens, 2010). Other professionals may work hard towards personal effectiveness, but most teachers strive to inspire their students to reach the learning goals.

Next, Teo, Lee and Chai (2007) defined facilitating conditions as factors present in the surroundings that may affect an individual’s desire to perform a task which may involve skill training, administrative support and the availability of materials and sufficient information on technology usage. Another predictor factor is personal innovativeness. Agarwal & Prasad (1998) introduced the term ‘personal innovativeness in the domain of information technology’ which is described as the willingness to take up and try a new information technology introduced. Personal innovativeness acts as the identifier of individuals who would possibly accept technology earlier than the others. Hence, the hypotheses of this study are:

H1: Critical mass positively affect perceived usefulness
H2: Learning opportunities positively affect perceived usefulness
H3: Facilitating conditions positively affect perceived usefulness
H4: Personal innovativeness positively affect perceived usefulness

2. Methodology
Respondents selected to participate in this study were 304 mathematics teachers in primary schools across Terengganu, Malaysia. A survey study was administered, where previously validated questionnaires were adapted and used in this study. Selected with the proportionate stratified sampling, the mathematics teachers then provided their demographics details and responded to 20 items which comprises of four items in perceived usefulness, three items for critical mass, five items for learning opportunities, facilitating conditions (three items) and three items for personal innovativeness. Each item was measured on a five-point Likert scale with 1(strongly disagree) to 5(strongly agree). These adapted items from numerous published sources have demonstrated good reliability in measuring the constructs employed in the present study. In this study, the reliability test conducted also yielded sufficient Cronbach’s alpha value for perceived usefulness (.956), critical mass (.876), learning opportunities (.948), facilitating condition (.892) and personal innovativeness (.812) indicating good reliability in the adapted questionnaire.
3. Results

The respondents’ general demographic information is that, from 304 Mathematics teachers participated, 126 (41.4%) of them are male teachers and 178 (58.6%) are female. Experienced teachers with more than 20 years of teaching mathematics are only 16.8 percent of those who took part in this study while most of them are between 11-20 years of experience in teaching mathematics. Almost all (95.1%) mathematics teachers in this study have Internet access at home. However, most of them only spend less than three hours a day to surf the internet. A small minority of 6.3% spent more than five hours a day surfing the net. It also shows that around 57.6% of the teachers use the eBook only about an hour or less in a day and the ones who use the eBook regularly more than 3 hours a day consist of only about 12.5% of the teachers surveyed.

Normality is one of the most important assumptions to be tested in a multivariate analysis for it refers to the normal data distribution for individual metric variables (Hair, Black, Babin, & Anderson, 2010). The assessment of univariate normality using AMOS is done by reporting the statistical skewness and kurtosis and the assumption of normality was met and fulfilled for each construct. Convergent validity determines the value of common variance in the indicators of each construct. As suggested by Hair et al. (2010), there are three ways to estimate convergent validity which is by assessing the factor loading, average variance extracted (AVE) and Construct Reliability (CR). The size of the factor loading should be 0.5 or larger. In this study, as shown in Table 2, all factor loadings are more than 0.7. The second measure is calculating the AVE and the criterion value of AVE accepted is 0.5 or higher (Hair et al., 2010). Thirdly, similar to the Cronbach’s alpha values, the construct reliability is met if the values of CR are 0.7 or higher. In this model, all values of CR are more than 0.7 and therefore, the initial measurement model satisfies the convergent validity.

Table 2. Results of the measurement model

<table>
<thead>
<tr>
<th>Construct</th>
<th>Factor loading</th>
<th>AVE (&gt;0.5)</th>
<th>CR (&gt;0.7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM1 Most teachers in my school use eBook frequently</td>
<td>0.892</td>
<td>0.736</td>
<td>0.893</td>
</tr>
<tr>
<td>CM2 Most mathematics teachers I know use eBook frequently</td>
<td>0.872</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CM3 My friends who are teachers in other schools use eBook frequently</td>
<td>0.808</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO1 eBook allows my students to experience things that they learnt about in the mathematics classroom</td>
<td>0.809</td>
<td>0.724</td>
<td>0.929</td>
</tr>
<tr>
<td>LO2 eBook offers opportunities for my students to interact with each other</td>
<td>0.785</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO3 eBook offers opportunities for my students to think critically</td>
<td>0.878</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO4 eBook offers opportunities to motivate students to learn mathematics</td>
<td>0.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LO5 eBook helps my students to explore mathematical ideas</td>
<td>0.878</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC1 When I need help to use the eBook, someone is there to help me</td>
<td>0.767</td>
<td>0.590</td>
<td>0.891</td>
</tr>
<tr>
<td>FC2 ICT Coordinator is always available to give advice on eBook usage in teaching</td>
<td>0.864</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC3 Executive Information Officer (EIO) is always available when there are technical problems</td>
<td>0.713</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC4 Guidance is available for me in the selection of software to choose for my mathematics lessons</td>
<td>0.72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI1 I want to explore the new eBook introduced</td>
<td>0.817</td>
<td>0.699</td>
<td>0.874</td>
</tr>
<tr>
<td>PI2 I like to experiment with new technologies</td>
<td>0.849</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI3 I think it is very interesting to try out new technologies</td>
<td>0.842</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use1 Using the eBook can improve my teaching performance in the mathematics classrooms</td>
<td>0.855</td>
<td>0.811</td>
<td>0.945</td>
</tr>
<tr>
<td>Use2 Using the eBook increases my teaching effectiveness in mathematics.</td>
<td>0.926</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use3 Using the eBook makes my mathematics teaching easier</td>
<td>0.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use4 Using the eBook helps my students to achieve better marks in mathematics</td>
<td>0.899</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The model fit of the research model in this study was tested using AMOS 21.0. Researchers usually employ different indices to determine model fit (Brown, 2006). Hair et al. (2010) suggested to at least test and report the one index from the incremental fit, one from the absolute fit index, one goodness-of-fit, and one badness-of-fit. Therefore, in the present study, the researcher has chosen to use four fit indices which are the CFI, TLI (incremental fit category), RMSEA (absolute fit category) and Chisq/df (parsimonious fit category) to test the model fit.

<table>
<thead>
<tr>
<th>Fit Indices</th>
<th>Values</th>
<th>Recommended values</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$/df</td>
<td>2.381</td>
<td>&lt; 3.0</td>
</tr>
<tr>
<td>TLI</td>
<td>.949</td>
<td>≥ .90</td>
</tr>
<tr>
<td>CFI</td>
<td>.958</td>
<td>≥ .90</td>
</tr>
<tr>
<td>GFI</td>
<td>.900</td>
<td>≥ .90</td>
</tr>
<tr>
<td>RMSEA</td>
<td>.068</td>
<td>&lt; .08</td>
</tr>
</tbody>
</table>

Hair et. Al (2010), (Schumacker & Lomax, 2010)

Discussion

Employing the Structural Equation Modeling, fitting our data to the model explained 62.6% of the variance in perceived usefulness of eBook use among mathematics teachers in Terengganu. The study also found that critical mass ($\beta = .170, p < .01$), learning opportunities ($\beta = .454, p < .001$) and facilitating conditions ($\beta = .215, p < .01$) have significant positive effects on teachers’ perceived usefulness of eBook use in teaching and learning. This findings are in congruent with current research (Bourgonjon et al., 2013; Moses, Wong, Kamariah, & Rosnaini, 2013). Learning opportunities were found the strongest determinant of perceived usefulness, which was seen parallel to the previous studies (Bourgonjon et al., 2013; De Grove et al., 2012; Roslina, et al., 2011).

Personal innovativeness however, was found not significant in affecting the perceived usefulness ($\beta = .096, p > .05$). This contradicted the findings of many studies previously done, including studies by Bourgonjon et al. (2013), Smet et al.(2012) and Liu, Li, & Carlsson (2010). This might be because that Mathematics teachers who are innovators, high in personal innovativeness are always willing to try new technologies and wanting to be the first to try something new, have seen more advanced technology such as the tablets and updated laptops and have become too familiar with computers such as the eBook, making them see the limited usefulness of the eBook as an effective learning tool. This however, could be validated by further research.

Conclusion

The study confirmed critical mass, learning opportunities and facilitating conditions as strong predictors of perceived usefulness of eBook among mathematics teachers. It is of significance relevance to the Ministry of Education and Education Department which are responsible for ushering in new developments and
technologies in the education system. Overcoming the teachers’ resistance to change has always been a major issue in managing changes. Hence, in ensuring smooth technology acceptance in a changed education scenario, such as this one-to-one eBook, the study clearly implied the need to seriously consider on holding carefully planned trainings and guidance for teachers, specifically on samples of good mathematics teaching and learning using the eBook and most importantly the digital textbook provided. Certain infrastructures such as the slow internet connection and the insufficient power supply to charge the individual eBook batteries were also brought up during the school visits. To show that the eBook provide high learning opportunities, information should be easily accessible, the digital textbook should not only consists of text and diagrams, but instead, complete with videos and animations that would get the students to see how to apply mathematics in everyday life, get to experience and experiment with their mathematical knowledge and explore mathematical ideas. Regarding critical mass, the encouragement and support from superiors and seeing successful usage among peers will motivate utilization of eBook by mathematics teachers. This research is however, done in a quantitative approach where the instruments used were only self-report questionnaires. It is recommended that the study could be more in depth, if done using more instrumentation such as interviews, classroom recordings and also observations. Future studies could be done using the mix method study, also including the quantitative part or could also be totally qualitative. This could provide more comprehensive insights and understanding of the students and also teachers on the acceptance of eBook in mathematics lesson.

References


Strategies for Improving Learning Performance by Using Crowdsourcing and Flipped Classroom

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Abstract: We conducted a survey indicating the wide variety of computer literacy and computer skills among college students. Most teachers suggest that new teaching strategies should be deployed. To resolve these issues, we propose a strategy for improving learning performance in the Introduction to Computers class based on the concepts of crowdsourcing and flipped classroom. The design strategy attempts to resolve common issues in training teachers, designing teaching activities, and sharing knowledge and teaching experiences simultaneously. To accomplish the above goals, we make use of a crowdsourcing system which serves multiple purposes including (1) the innovation of teaching ideas; (2) the enhancement of instructor engagement and training process; and (3) the improvement of sharing knowledge and teaching experiences. To verify the proposed approach, an experiment involving over 10,000 students will be conducted.

Keywords: crowdsourcing, flipped classroom, MOOCs

1. Introduction

Although computers are popular in the current information era, not all students are able to take the full advantage of it. According to our survey, college students have a wide range of computer literacy and skills. Furthermore, most teachers suggest that new teaching strategies should be deployed. In this paper, we propose a strategy for improving learning performance in the Introduction to Computers class based on the concepts of crowdsourcing and flipped classroom in order to resolve these challenging issues.

Crowdsourcing was coined by J. Howe in 2006 [1]. Crowdsourcing systems enlist a multitude of humans to help solve a wide variety of problems. Prime examples include Wikipedia, Linux, Yahoo! Answers, and Mechanical Turk-based systems [2]. Strategies are known as crowd wisdom, crowd creation, crowd funding, and crowd voting [3]. However, applications of crowdsourcing are not only extensively used in general public domains, but also in the education field. In the web site of The Chronicle of Higher Education, examples and undergoing research projects in crowdsourcing can be found [4]. To implement crowdsourcing, open source and commercial platforms are available [5].

NY Times declared that 2012 is the year of MOOCs [6]. There are three MOOCs key players, Coursera, Udacity, and edX today. One of the key features in which a MOOC differs from traditional online classes is that MOOCs video clips are short (usually less than 15 minutes). The length of these videos take into consideration human cognition loading. With these video clips available, the concept of flipped classroom can be easily implemented. As a result, we integrate crowdsourcing and flipped classroom together to improve the learning performance. To verify the effectiveness of the design strategy, we also design an experiment involving over 10,000 participants. Data will be collected for further analysis from different dimensions.
2. Problem Statement and Design Strategy

In this section, we describe the survey and its results. In addition, we propose a corresponding strategy to resolve issues evident in the results of our survey.

2.1 Problem Statement

A survey is conducted to probe the computer literacy and skills of college freshmen. There are 10 items and five levels (not familiar to very familiar) for each category of computer skills. As shown in Figure 1, the survey indicates that the familiarity levels of students vary greatly. We also investigate what students expect to learn and what teachers think students should learn in the Introduction to Computers course. As shown in Figure 2 and Figure 3, the survey shows that the students’ expectations and the teachers’ opinions do not match well. It also indicates that the teachers’ opinions are not unanimous. However, more than 70% of teachers suggest that the teaching strategy should be improved. Based on the survey mentioned above, we draw the following conclusions:

(1) the course content and activities should be present in a variety of ways to better suit the students;
(2) a mechanism that can enable teachers to generate ideas and share knowledge would be beneficial.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Option</th>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Typing in English and Chinese</td>
<td>22(4.1%)</td>
<td>103(19.59%)</td>
<td>198(36.64%)</td>
<td>142(26.49%)</td>
<td>45(8.27%)</td>
<td></td>
</tr>
<tr>
<td>(2) Software install and uninstall</td>
<td>56(10.45%)</td>
<td>100(18.66%)</td>
<td>115(21.46%)</td>
<td>170(31.72%)</td>
<td>95(17.72%)</td>
<td></td>
</tr>
<tr>
<td>(3) Use of Windows</td>
<td>56(10.45%)</td>
<td>117(21.83%)</td>
<td>159(29.66%)</td>
<td>144(26.87%)</td>
<td>60(11.19%)</td>
<td></td>
</tr>
<tr>
<td>(4) Use of Word</td>
<td>62(11.57%)</td>
<td>128(23.88%)</td>
<td>150(27.99%)</td>
<td>144(26.87%)</td>
<td>52(9.79%)</td>
<td></td>
</tr>
<tr>
<td>(5) Use of Excel</td>
<td>104(19.4%)</td>
<td>123(22.32%)</td>
<td>162(31.53%)</td>
<td>100(18.66%)</td>
<td>38(7.09%)</td>
<td></td>
</tr>
<tr>
<td>(6) Use of PowerPoint</td>
<td>122(22.76%)</td>
<td>132(24.63%)</td>
<td>157(29.29%)</td>
<td>92(17.16%)</td>
<td>33(6.16%)</td>
<td></td>
</tr>
<tr>
<td>(7) Deal with simple computer abnormal</td>
<td>191(35.63%)</td>
<td>178(33.21%)</td>
<td>101(18.84%)</td>
<td>44(8.21%)</td>
<td>22(4.1%)</td>
<td></td>
</tr>
<tr>
<td>(8) Simple image and audio editing</td>
<td>221(41.23%)</td>
<td>159(29.66%)</td>
<td>98(18.28%)</td>
<td>45(8.4%)</td>
<td>13(2.43%)</td>
<td></td>
</tr>
<tr>
<td>(9) Install operation system</td>
<td>313(58.21%)</td>
<td>112(20.99%)</td>
<td>68(12.69%)</td>
<td>32(5.97%)</td>
<td>12(2.24%)</td>
<td></td>
</tr>
<tr>
<td>(10) Computer programming</td>
<td>406(75.53%)</td>
<td>73(13.62%)</td>
<td>44(8.21%)</td>
<td>7(1.31%)</td>
<td>6(1.28%)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Computer skills of college freshmen vary greatly.
2.2 Strategy for improving learning performance

We propose the following strategy to resolve the challenging issues mentioned in Section 2.1. The main concept is depicted in Figure 4. It consists of four main mechanisms: MOOCs videos, idea generation, flipped classroom, and performance evaluation. First, we prepare videos in MOOCs format for students to learn course materials and discuss with classmates online. Second, instructors work together in a crowdsourcing system to generate teaching ideas and design suitable class activities for students. Third, we conduct flipped classroom in class. Fourth, the corresponding data will be collected to perform further analysis to improve the design. The preparation of MOOC videos will be executed in a consistent manner. Our focal points are the crowdsourcing system and performance evaluation, which we will elaborate in more detail in Section 3.
3. System Overview and Crowdsourcing System

3.1 Framework of the System

Let us consider several common challenges with teaching on-site at many educational institutions: (1) how to execute instructor training; (2) how to share teaching and learning experiences; and (3) how to do teaching evaluation. In this section, we propose strategies to simultaneously resolve the above issues. In the realm of learning, co-construction is an approach whereby the emphasis is in working collaboratively or in partnerships. ‘Co-construction of learning’ deepens relationships and understanding between all learning partners and can lead to improvements in the quality of education (Wikipedia, 2013). The designed system targets co-construction between instructors and instructional designers. The corresponding design philosophy and framework of the system are described in this section.

First, the instructors and/or instructional designers that will engage in the course design and lecture delivery are invited to be the participants of co-construction. Participant requirements include familiarity in relevant areas such as (1) pedagogic design; (2) course content; and (3) lecture delivery. The design philosophy, as shown in Figure 5, is based on the funnel of content creation, which is inspired by the ‘marketing funnel’, an idea in widespread use in marketing and sales (D. Clow, 2013). By way of analogy, we have four stages in our design framework:

- Awareness – instructors understand the target material and task (e.g., specific chapter, section, or knowledge node);
- Acquisition – instructors enhance teaching activities by query, peer discussion, and any knowledge acquisition processes;
- Action – instructors create their learning activities or modify other instructors’ inputs, i.e., an ideation step;
- Consequence – the leader of the activity designers terminates the design process and concludes with final results.

Figure 5. The funnel of idea generation
In order to implement the design philosophy mentioned above, four mechanisms are designed. We elaborate each mechanism in detail as follows.

- **Awareness**: Mechanism of participant invitation and task awareness
  Materials of benefit to participants are provided to orientate themselves. This consists of functions such as an invitation to the participants, a description of the lecture, a description of the lecture format and style, an announcement and confirmation, a guided procedure with templates and tools to help keep track of the task, a best practice guide and tutorials, and a record of the participants’ usage.

- **Acquisition**: Mechanism of co-construction of learning activities
  The co-construction of learning activities is executed in this mechanism. It includes reading and offering comments and suggestions on the lecture content, designing learning activities, and selecting the preferred content and learning activities. This process is a knowledge generation and filtering preparation phase.

- **Action & Consequence**: Mechanism of lecture accomplishment
  Knowledge filtering and sharing occurs in this mechanism. At the appropriate time, the leader of the co-construction concludes with the final result and produces the top-ranked learning activities. Subsequently, he/she informs all participants of these activities.

- **Feedback**: Mechanism of outcome evaluation and analysis
  The feedback mechanism collects information related to instructor class experience, learners’ assessment and survey, etc. to improve the co-construction mechanisms as well as lecture content and pedagogy design.

In order to ensure the quality of outcome, being able to smoothly transition between stages is also important. For instance, participants are not allowed to begin the acquisition stage before they complete the awareness stage. Based on the above description, the corresponding learning platform and tools will be supported in the implementation phase. Meanwhile, encouragement policies for participation will be designed.

### 4. Experimental Design

To validate the above design, a common course “Introduction to Computers” is selected. Four schools and over 100 instructors and 10,000 students will join the pilot study.

#### 4.1 Syllabus

“Introduction to Computers” (G. L. Chen, 2009), the selected textbook, consists of 12 chapters and labs. Each chapter will be transformed into MOOCs format and includes text, videos, quizzes, discussion, and learning activities (Coursera, 2013). Instructional designers first divide each chapter into suitable knowledge nodes. The video length of each knowledge node is around 10 minutes. Instructors are asked to contribute in quizzes, discussion topics, and learning activity design tasks by following the designed format described in the co-construction management system.

#### 4.2 Class Type

To gain a better understanding of learners’ behaviors and their learning results, we arrange four types of learning classes for the experiment. Note that the size of each class may not be equal.

- **Class Type A**: online classroom only
  Students only take classes and read learning materials online

- **Class Type B**: flipped classroom
  Students attend classes on-site in the classroom and read learning materials online

- **Class Type C**: regular classroom
  Students attend classes on-site and are encouraged to read the learning materials online

- **Class Type D**: open online class
  Students attend classes on-site and gain free access to the learning materials online.
The lecture content and learning activities on the web will be available on a MOOC platform, the digital learning environment for all students and instructors. Meanwhile, instructors will be asked to access the lecture content co-construction management system to record and report the processes.

4.3 Data Acquisition

Data and survey from different dimensions, such as stakeholders, instruments, and objectives will be collected to perform further analysis. These data collections are mainly from MOOCs platform and lecture content co-construction management system. In each lecture unit, data collected include, but are not limited to, the following:

- Students: ePortfolio, log file data, assessment (formative and summative), resource utilization, discussion board action, learning outcomes.
- Teachers: log file data, engagement, content contribution, idea generation and sharing, feedback.

4.4 Data Analysis and Information Flow

Although the data collected can be applied to different research objectives, the main focal points of our evaluation are co-construction strategy and mechanisms. The learning analytics mechanism takes inputs from MOOCs platform and co-construction management, and its outputs are of benefit to the areas of pedagogy, research, and administration.

5. Conclusion and Future Work

A strategy to improve student learning performance in the Introduction to Computers is proposed in this paper. By using the crowdsourcing system, we expect the instructors to gain knowledge and familiarity in the lecture content and learning activities. As a result, it may reduce the load of preparing for class for the instructor and improve the quality of their teaching. The above goals will be verified via the designed experiment involving more than 10,000 learners. Data collected from MOOCs platform and co-construction system will be analyzed. This is a pilot program. The experience and results obtained will be conducive to the enhancement of the co-construction system as well as the improvement of teaching and learning. It also paves the way to design more MOOC lectures effectively.

References

Students’ conceptions of and approaches to knowledge building: A phenomenographic method

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Abstract: This study explored primary school students’ conceptions of and approaches to knowledge building using a phenomenographic method. A total of 48 students participated in the present study. Five qualitative conceptions of knowledge building, namely “building up knowledge,” “sharing ideas,” “obtaining ideas,” “discussing ideas” and “improving ideas,” and five approaches to knowledge building, namely “seeking for the related information,” “contributing what I know,” “receiving more ideas,” “discussing ideas for better understanding” “getting feedback for making ideas refined” were revealed. These different and hierarchically related categories show the perspectives as experienced by the students. The results indicated that the students with fragmented conceptions tended to use surface approaches while those with cohesive conceptions tended to adopt deep approaches.

Keywords: Conceptions of learning, approaches to learning, knowledge building

1. Introduction

Within the computer-supported collaborative learning (CSCL) literature, knowledge building has received much attention in recent decades. It describes how students can be engaged with online discourse to develop new knowledge within a community through the use of discussion forums, mainly the Knowledge Forum (Chan, 2011). Scardamalia & Bereiter (2010) distinguish between knowledge building and learning; they see learning as “a personal matter, but knowledge building is done for the benefit of the community.” (p.2). Knowledge building highlights the creation and modification of ideas as public knowledge that lives ‘in the world’, and can be further improved by other people. Based on the extensive research conducted on the knowledge building pedagogy, Scardamalia (2002) has distilled twelve principles or social-cognitive and technological contributing factors that are essential for fostering a knowledge building culture in a classroom. These principles, include (a) real ideas, authentic problems, (b) improve ideas, (c) idea diversity, (d) rise above, (e) epistemic agency, (f) community knowledge, collective responsibility, (g) democratizing knowledge, (h) symmetric knowledge advancement, (i) pervasive knowledge building, (j) constructive uses of authoritative sources, (k) knowledge building discourse, and (l) embedded and transformative assessment. Essentially, these principles engage students in addressing problems of understanding they are personally confronted with, articulating their initial understanding as ideas and subsequently treating the ideas as improvable cognitive artifacts. The students assume the responsibilities as a community to respectfully examine the diverse ideas proposed through collaborative discourse that aims to improve their collective understanding. The ideas are therefore discussed and compared to authoritative sources and sometimes empirical testing, and are assessed and sometimes transformed as higher level cognitive artifacts. These principles not only guide teachers and researchers to design their lesson activities and teaching strategies, but also to evaluate the extent of knowledge advancement within the community (Hong & Scardamalia, 2014).
Recently, a growing body of research has investigated students’ conceptions of and approaches to learning in educational research, such as conceptions of and approaches to learning through peer assessment (Yang & Tsai, 2010), conceptions of and approaches to learning through online discussion (Ellis, Goodyear, Prosser, & O’Hara, 2006), conceptions of learning management (Lin & Tsai, 2011), and conceptions of and approaches to online argumentation (Tsai & Tsai, 2013). Conceptions of learning are related to what the students think about the learning process and its purposes (Benson & Lor, 1999) while approaches to learning are concerned with how students approach their learning (Yang & Tsai, 2010). In this line of research, phenomenographic method was utilized to explore individual variations in the perceptions of the phenomenon experienced by the students. The phenomenographic method is a qualitative method, and is used to document individual experiences and classify the variations into hierarchically related categories (Åkerlind, 2005; Richardson, 1999). For example, in the pioneering study of Säljö (1979), five qualitatively different, hierarchically related conceptions were revealed, including “increase of knowledge,” “memorizing,” “acquiring facts or procedures that can be retained and/or utilized in practice,” “abstraction of meaning,” and “an interpretative process aimed at the understanding of reality.” Hence, following this research method, the hierarchically related conceptions and approaches were found, and also revealed students’ different views of learning that have implications for improving how teachers design and practice their instruction.

Moreover, many researchers have categorized conceptions of learning as fragmented and cohesive conceptions (Ellis et al., 2006). Fragmented conceptions refer to a limited understanding of the learning resources and environment where students fail to take advantage of it while cohesive conceptions refer to a comprehensive understanding of the learning resources and environment that students can leverage to enhance their learning. Ellis et al. (2006) revealed that students with cohesive conceptions tend to have better learning outcomes than those with fragmented conceptions. Likewise, approaches to learning can be classified into surface and deep approaches (Yang & Tsai, 2010). Surface approaches reveal that students engage in the learning activity for reproduction. Deep approaches reveal that students engage in the learning activity for real understanding. Unsurprisingly, Ellis, Goodyear, Brillant and Prosser (2008) indicated that students with deep approaches tend to outperform than those with surface approaches.

By using dichotomous views (i.e. fragmented versus cohesive conceptions, and surface versus deep approaches), many studies found the positive relationships between students’ conceptions of and approaches to learning (Lee, Johanson, & Tsai, 2008). For example, Yang and Tsai (2010) revealed that the college students who held fragmented conceptions of learning through peer assessment tended to adopt surface approaches while those who held cohesive conceptions tended to use deep approaches. The results of these studies implied that students’ conceptions of and approaches to learning may be important for their learning. In the present study, we are interested in investigating how students developed their conceptions of and approaches to knowledge building after engaging in knowledge building as a community in a social study class. Therefore, the present study aimed to examine students’ conceptions of and approaches to knowledge building. The research questions are showed as below:

- Using the phenomenographic method, what are the students’ conceptions of knowledge building?
- Using the phenomenographic method, what are the students’ approaches to knowledge building?
- What are the relationships between students’ conceptions of and approaches to knowledge building?

2. Method

2.1 Participants

The participants of this study consisted of 48 primary school students ranging in age from 9 to 11 years (consisted of 23 primary three and 25 primary four students; 19 females and 29 males). All of the students had experienced knowledge building activities in social studies classes for one year (a 35-minute period weekly). The curriculum plan of the primary three and four social studies is to enhance civic-mindedness among students through an understanding of Singapore’s past and present. In
the knowledge building activities, students were encouraged to interact and discuss the issues with their peers online by using the Knowledge Forum™.

2.2 Data collection and analysis

To understand the students’ conceptions of and approaches to knowledge building, the interview questions were constructed based on Tsai (2009), Yang and Tsai (2010), and shown as below.

- What were the knowledge building activities about? Please share with me your experiences last year.
- Based on your experience, what do you think is the meaning of knowledge building activities?
- When your friends, who did not attend the knowledge building activities, ask you about the knowledge building activities, what will you tell them?
- What do you think about the purpose of knowledge building activities?
- Given a choice, would you still want to take part in knowledge building activities? Why?
- What have you done during knowledge building activities?
- What strategies did you use and why did you adopt those strategies in the knowledge building activities?
- What were some of the things you learnt from the knowledge building activities?
- How do you know when you have learned something through knowledge building activities?

The first five questions explored the students’ conceptions of knowledge building, while the rest investigated the students’ approaches to knowledge building. Moreover, the phenomenographic method (Richardson, 1999) and the most dominant category (Koballa, Gaber, Coleman & Kemp, 2000; Tsai & Kao, 2008) were utilized to analyze the students’ interview responses, which were applied as a major data source to examine their conceptions of and approaches to knowledge building.

Firstly, this study utilized the phenomenographic method to identify qualitatively different categories for describing students’ conceptions of and approaches to knowledge building. That is, the authors read the whole interview responses, chose the significant sentences, and then marked the main ideas which were able to represent the students’ conceptions of and approaches to knowledge building. The authors also compared the significant sentences and the marked ideas to find out the similarities and differences between the students’ responses. The hierarchically related categories of students’ conceptions of and approaches to knowledge building were then constructed in this study.

Similar to previous studies (Koballa et al., 2000; Tsai & Kao, 2008), this study also found that the students had mixed views of conceptions and approaches; hence, following the most dominant category, the authors identified each student’s highest frequency idea as the most significant conception and approach to represent his/her views of knowledge building. For instance, Tsai and Tsai (2014) revealed four categories of college students’ conceptions of online argumentation, involving expressing ideas, discussing ideas, negotiating ideas, and reflecting on and extending ideas. If a student had many utterances around “discussing ideas” but a few utterances about “negotiating ideas,” these utterances would be grouped into the category of “discussing ideas.”

After the classification of interview responses, 20 out of all students were randomly chosen and their interview responses were classified by another author using the same coding criteria. The percentage of agreement was applied to measure the reliability of the two researchers’ coding. The percentage of agreement with regard to the conceptions and approaches were 80% and 85%, respectively. For the remaining data that were not subjected to inter-rating, the researchers reviewed and discussed the interview responses together, and then determined final classifications.

3. Findings

989
3.1 Conceptions of knowledge building

Five different conceptions of knowledge building were identified by using the phenomenographic method. The categories range from A (highly fragmented conception) to E (highly cohesive conception) showing the hierarchically different conceptions of knowledge building as experienced by the students.

A. **Knowledge building as a way of building up knowledge.** Students conceptualized knowledge building as gaining and accumulating more knowledge from Internet. The purpose of knowledge building was to find more information about the theme under study.

B. **Knowledge building as a way of sharing ideas.** Students characterized knowledge building as a way of sharing ideas and information on Knowledge Forum. The purpose of knowledge building was to express and share their views.

C. **Knowledge building as a way of obtaining ideas.** Understanding classmates’ ideas about the theme inquired was viewed as the main features of knowledge building. The purpose of knowledge building was to know others’ perspectives.

D. **Knowledge building as a way of discussing ideas.** Trying to integrate and discuss the peers’ ideas was viewed as the major features of knowledge building. Hence, students classified in this category not only shared information, but also the higher-level cognitive processes needed in knowledge building activities.

E. **Knowledge building as a way of improving ideas.** Knowledge building was characterized in terms of improving ideas. The purpose of knowledge building was the improvements of ideas or obtaining more complete understanding of a theme.

3.2 Approaches to knowledge building

Five qualitatively different approaches to knowledge building were identified by using the phenomenographic method. The categories from A, which is related to a highly surface approach, to E, which is related to a highly deep approach, reveal hierarchically different approaches to knowledge building as experienced by the students.

A. **Engaging in knowledge building to seek for the related information.** This approach to knowledge building highlighted seeking for the related information about the theme from the Internet. The students tended to emphasize information finding is a necessary process in knowledge building activities.

B. **Engaging in knowledge building to contribute what I know.** This approach to knowledge building stressed providing more ideas. The students seemed to expect that they could tell more ideas they known.

C. **Engaging in knowledge building to receive more ideas.** This approach highlighted providing their opinions to receive more ideas. The students seemed to expect that they could get more feedback from peers.

D. **Engaging in knowledge building to discuss ideas for better understanding.** This approach to knowledge building stressed discussing with peers to increase their understanding about a theme.

E. **Engaging in knowledge building to get feedback for making ideas refined.** This approach to knowledge building emphasized discussing with peers to re-think or reflect on their ideas in a more cohesive way. The students seemed to expect that they could refine their ideas.

3.3 The distribution of students’ conceptions of and approaches to knowledge building

The distribution of variation in conceptions of and approaches to knowledge building are shown in Table 1. As to student’ conceptions, 68.7% (n = 33) of interview responses were classified as fragmented, and 31.3% (n = 15) as cohesive. As to students’ approaches, 72.9% (n = 35) of interview responses were classified as surface, and 27.1% (n = 13) as deep. It implies that most students were viewing knowledge building in a fragmented way and used a surface approach.

Table 1: The distribution of students’ conceptions of and approaches to knowledge building.

<table>
<thead>
<tr>
<th>Type</th>
<th>Category</th>
<th>Counts</th>
</tr>
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<tbody>
<tr>
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<td></td>
</tr>
</tbody>
</table>

990
Conceptions of knowledge building

<table>
<thead>
<tr>
<th></th>
<th>Fragmented</th>
<th>Cohesive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>16 (33.3%)</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>7 (14.6%)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>10 (20.8%)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>9 (18.8%)</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>6 (12.5%)</td>
<td></td>
</tr>
</tbody>
</table>

Approaches to knowledge building

<table>
<thead>
<tr>
<th></th>
<th>Surface</th>
<th>Deep</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18 (37.5%)</td>
<td>8 (16.7%)</td>
</tr>
<tr>
<td>B</td>
<td>7 (14.6%)</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>10 (20.8%)</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>5 (10.4%)</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
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</tbody>
</table>

### 3.4 The relations between students’ conceptions of and approaches to knowledge building

To explore the relations between conceptions of and approaches to knowledge building, the Pearson chi-square test was conducted in this study. As shown in Table 2, the results showed that there was a significant relations between students’ conceptions of and approaches to knowledge building ($\chi^2 (1, n = 48) = 21.86, p < 0.001$). It implies that students with fragmented conceptions tend to use surface approaches, while those with cohesive conceptions tended to use deep approaches.

Table 2: The relations between students’ conceptions of and approaches to knowledge building.

<table>
<thead>
<tr>
<th>Approaches/Conceptions</th>
<th>Fragmented</th>
<th>Cohesive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>29</td>
<td>5</td>
</tr>
<tr>
<td>Deep</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

$\chi^2 (1, n = 48) = 21.86, p < 0.001$

### 4. Discussion and conclusions

This study investigated students’ conceptions of and approaches to knowledge building by using the phenomenographic method. Five qualitative conceptions of knowledge building, namely “building up knowledge,” “sharing ideas,” “obtaining ideas,” “discussing ideas” and “improving ideas,” and five approaches to knowledge building, namely “seeking for the related information,” “contributing what I know,” “receiving more ideas,” “discussing ideas for better understanding,” “getting feedback for making ideas refined” were revealed. These different and hierarchically related categories show the perspectives as experienced by the students.

Our findings showed that in accordance with the fragmented and cohesive conceptions, more than half of the students held fragmented conceptions (i.e. building up knowledge, sharing ideas and obtaining ideas). Similarly, according to the surface and deep approaches, more than half of the students held surface approaches (seeking for the related information, contributing what I know, and receiving more ideas). Moreover, this study also found that students’ conceptions are related to their approaches; that is, students with fragmented conceptions tended to use surface approaches while students with cohesive conceptions tended to adopt deep approaches. The results are consistent with the studies of Bliuc, Ellis, Goodyear and Piggott (2011), and Yang and Tsai (2010). The findings extended current research of conception of learning and points out that the deep and surface continuum is applicable to conception of knowledge building and there is a need to pay attention to the less desirable conceptions that have been formed.
Many researchers have investigated the relationships among students’ experiences of learning and the learning outcomes, including the relationships among conceptions of online argumentation, and the quality of online argumentation (Tsai & Tsai, 2014), and the relationships among conceptions of learning via peer assessment, approaches to learning via peer assessment and learning outcomes (Yang & Tsai, 2010). Those studies provided some insights into students’ learning processes from students’ views. Therefore, future studies are encouraged to examine the relationships between students’ perceptions of knowledge building and their knowledge building processes.

Acknowledgements

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References

Influence of ICT-Supported Learning Environment Perceptions, Academic Ability, and Prior Educational Experience on Approaches to Learning for Accounting in Malaysian Secondary Schools

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Abstract: This study reviews selected influencing factors on students’ approaches to learning for accounting in the ICT-supported learning environment, namely the students’ perceptions of learning environment, academic ability, and prior educational experience. The retrieved research reports reveal that the learning environment which is perceived as being tensed up with pressure and demands would influence students to adopt surface approaches to learning. However, the ICT-supported learning environment that contributed to the perceptions of interactivity and involvement, inquiry and investigation, authenticity of learning, cooperation, and differentiation would stimulate deep approach to learning. Furthermore, academic ability could positively or negatively influence approaches to learning. Lastly, the availability and quality of prior educational experience could influence deep approach to learning, while problematic prior educational experience would lead to surface approach to learning.

Keywords: Deep approach to learning, surface approach to learning, perceptions of ICT-supported learning environment, academic ability, prior educational experience, accounting

1. Introduction

Accounting is one of the important professions for nation building which covers a wide spectrum of economic events in business enterprise and national economic activities. However, accounting is always regarded as a technical-oriented subject and it has been dominated by the objective of training students to know facts and solve problems from a narrow and inadequate perspective and thus, students used to take a surface approach to learning (Eley, 1992; Booth, Luckett, & Mladenovic, 1999; Lucas, 2000).

Likewise, in the context of Malaysia, the learning of accounting has yet to achieve deep approach, particularly at the level of fundamental accounting in secondary schools. It was found that most of the accounting teachers tended to focus on the procedural aspect of the subject by using the teacher-centred teaching approach without delving deeper into the knowledge (Suhaida Abdul Kadir, 2002; Hanuni Yusuf, 2003; Rohaila Yusof, 2006). This may be a reflection of the education system which has overemphasised students’ academic achievement (Kementerian Pelajaran Malaysia [Ministry of Education], 2006) and many teachers are unwilling to take the risk of students’ failure in examination by attempting innovative teaching. They would rather employ teacher-centred teaching methods which comply with the requirements of the exam-oriented education system. Moreover, students are short of the ICT skills to adopt deep approach to learning for managing the whole set of accounts by relating the processes of accounting cycle into a coherent whole (Arfah Salleh, 2001; Rashidah Hassan & Arfah Salleh, 2008; Tan & Wong, 2012).

In view of the weaknesses of the accounting education, a revised curriculum and assessment was launched by Ministry of Education in 2010. It involves consolidating the fundamental accounting...
education by emphasising on the use of ICT skills for preparing a full set of accounts, soft skills, and ethical aspects of the accounting profession (Bahagian Pembangunan Kurikulum [Curriculum Development Section], 2009). However, to what extent the revised curriculum and assessment are able to foster students’ deep approaches to learning, particularly under the ICT-supported learning context? Thus, in this review study, it is set forth to uncover the factors that may contribute to students’ approaches to learning so that important information can be acquired for applying technology-enhanced pedagogy for better teaching and learning of accounting in Malaysian secondary schools.

1.1 Students’ Approaches to Learning (SAL)

SAL is defined as the ways in which how a student perceived a particular academic task and then handle it (Marton & Säljö, 1976). In addition, SAL is seen as a contextually dependent response rather than an enduring characteristic of the individual (Meyer, Parsons, & Dunne, 1990). It is further identified into two contrasting approaches i.e. deep approach and surface approach. A deep approach entails learners’ intrinsic motivation and interest to attempt to understand the meaning of the learning material and relate parts to each other, new ideas to previous knowledge or to personal meaningful context; whereas a surface approach is characterised by extrinsic motivation to acquire only sufficient knowledge to complete the task or pass the subject and thus, learners tend to memorise separate facts and/or view a particular task in isolation from other tasks and real life as a whole (Marton & Säljö, 1976; Biggs, 1985; 1987; Biggs and Moore, 1993; Biggs, Kember, & Leung, 2001; Kember, Biggs, & Leung, 2004).

1.2 Factors Influencing Approaches to Learning

Based on the Presage-Process-Product (3Ps) Model proposed by Biggs (1985) which explains why students learn and act differently in their processes of learning by delineating the important stages in learning i.e. Presage, Process, and Product, the author proposed that students’ personal and situational factors which exist at the presage stage of learning or before learning takes place influence the learning process which is represented by learning approaches. In this vein, students’ personal factors include their individual characteristics in terms of prior knowledge for a learning subject, abilities, personality, and home background; while situational factors of learning environment consists of the variables such as subject area, teaching method, time on task, task demand, and course structure. Furthermore, Ramsden (2003) adapted the 3Ps model by highlighting students’ perceptions of learning environment which exist as an important presage factor to influence approaches to learning. In other words, it is not the learning environment in itself that influences learning, but the way students perceive it. As a consequence, several factors were selected for investigation and the research questions addressed in this review study are:

- Do students’ perceptions of ICT-supported learning environment significantly influence approaches to learning?
- Does academic ability significantly influence approaches to learning?
- Does prior educational experience significantly influence approaches to learning?

2. Methodology

To answer the aforementioned research questions, studies that investigated the influence of ICT-supported learning environment with specific focus on examining the relationship between students’ perceptions of learning environment, academic ability, and prior educational experience on students’ approaches to learning were explored. The search terms were “approaches to learning”, “ICT-supported learning environment”, “constructivist learning environment”, “student-centred learning environment” combined with key words of “perceptions”, “academic ability”, “student at risk”, “prior educational experience”, or “prior knowledge”. For the acquisition of the articles related to accounting education, additional keywords were entered i.e. “accounting”, “accounting education”, “accounting learning”, and “accounting teaching”. This literature search was conducted by means of the electronic search through several wellknown and established databases such as Taylor & Francis, Emerald Management Xtra Plus, Sage
Journals Online, SpringerLink, Wiley-Blackwell, and Science Direct. The abstracts of the studies were reviewed and the selected literatures were based on several criteria i.e. (1) the studies had to address students’ approaches to learning consisting of motive and strategy to tackle a task; (2) the studies had to clearly address the relationships between the influencing factors (i.e. students’ perceptions of learning environment, academic ability, and prior educational experience) and approaches to learning; and (3) the studies had to use computer or internet technologies for teaching and learning.

3. Results

3.1 Do Students’ Perceptions of ICT-Supported Learning Environment Significantly Influence Approaches to Learning?

There have been many studies reporting that significant relationships exist between students’ perceptions of learning context and approaches to learning. It was found that approaches to learning are influenced by different perceptions of students studying different subject areas (Ramsden, 1979). In this vein, accounting students were especially influenced by their learning context which perceived as being tensed up with pressure and demands from the professional accounting bodies and there was evidence that most of them adopt the surface approaches to learning (Eley, 1992; Gow, Kember, & Cooper, 1994; Sharma, 1997; Booth et al., 1999; Jackling, 2005; Lord & Robertson, 2006; Abraham 2006). On the other hand, deep approach to learning was found to be associated with perceived quality teaching support (Eley, 1992; Chan & Watkins, 1994; Lizzio, Wilson, & Simons, 2002), appropriate pedagogy which encourages independence, interaction, and inquiry (Eley, 1992; Abraham, 2006), and appropriate assessment (Abraham, 2006; Watty, Jackson, & Yu, 2010).

Furthermore, the ICT-supported learning environment is especially contributing to students’ perceptions of interactivity and involvement (Maor, 2000; Law, Lee, & Chow, 2002; de Lange, Suwardy, & Mavondo, 2003; Jebeile & Abeysekera, 2010; Premuroso, Tong, & Beed, 2011), inquiry and investigation (Basu & Cohen, 1994; Siragusa, 2002; Jones, Scanlon, Gaved, Blake, Collins, Clough et al., 2013), authenticity of learning (Basu & Cohen, 1994; Green, Reinstein, & Mc Williams, 2000; Murphy & Hoeppner, 2002; Marriott, 2004; Stanley & Edwards, 2005; Neal 2005), cooperation (Rumpagaporn, 2007), and differentiation (Jebeile & Abeysekera; 2010) as well as the perceptions of teacher support (Rumpagaporn, 2007; Lillie & Wygal, 2011). These perceptions were found contributing to students’ deep approaches to learning. Meanwhile, the ICT-supported learning environment perceived by students to have replaced them by producing the accounting reports automatically (Green et al., 2000) and being a safety net for absence (Wells, de Lange, & Fieger, 2008) were associated to surface approaches to learning.

3.2 Does Academic Ability Significantly Influence Approaches to Learning?

Academic ability refers to a person’s capacity to study which is measured by his or her prior performance in examinations (Auyeung & Sands, 1994; Lizzio et al., 2002; Duff, 2004). Several studies reveal that students with low academic abilities were associated to surface approaches to learning and conversely, those with high academic abilities tended to perform deep approaches to learning (Holschuh, 2000; Duff, 2004; Tang, 2008). In addition, the low academic ability in terms of English competency was related to surface approach to learning (Gow et al., 1994; Kember, Ng, Tse, Wong, & Pomfret, 1996; Kember & Leung, 1998; Watty et al., 2010). This phenomenon was explained by the authors that due to the students’ limited ability to decipher text written in English, they were likely to adopt surface strategy of memorising key words.

On the other hand, Lizzio et al. (2002) revealed that students with higher academic ability tended to use surface approach. This in particular applied to commerce students while the researchers found that science students demonstrated positive influence of academic ability to deep approaches to learning. Finally, Auyeung and Sand (1994) found that academic ability was only related to surface approach to learning. Overall, the past studies prove that academic ability is significantly related to surface or deep approach to learning.
3.3 Does Prior Educational Experience Significantly Influence Approaches to Learning?

A student’s prior educational experience refers to a person’s previous experiences of educational settings (Ramsden, 2003; Biggs, 2003). It provides prior knowledge before entering any actual learning context, which is important in determining learning. Many studies reveal that prior educational experience is related to approaches to learning. Most of the studies stress that availability of prior educational experience can influence deep approach to learning vice versa (Ramsden, 1979; Richardson, Morgan, & Woodley, 1999; Tempone, 2001; Dochy, De Rijdt, & Dyck, 2002; Harmer, 2009). Abhayawansa, Tempone, and Pillay (2012), on the other hand, focus on the quality of prior educational experience based on different learning environments i.e. students from conventional and technical schools. In this vein, learning environment which emphasises on the development of adaptability, innovativeness, and problem-solving was most likely to influence deep approach to learning. Furthermore, some of the studies focus on the negative aspect of prior educational experience. These studies highlighted that the problematic prior knowledge would lead to surface approach to learning (Crawford, Gordon, Nicholas, & Prosser, 1998; Lucas, 2000; 2001; McGowen & Tall, 2010).

4. Conclusion

Based on the aforesaid studies, this review study concluded that students’ approaches to learning are significantly influenced by their perceptions of ICT-supported learning environment, academic ability, and prior educational experience. The results of this review study could serve as a basis for new studies to fill in the gaps in the corpus of knowledge regarding approaches to learning, particularly in the scope of accounting education and educational technologies. Future studies should be conducted to investigate several other factors which may influence students’ approaches to learning in ICT-supported learning environment such as individual student’s personality, socioeconomic background, and motivational factors.

References


The Undergraduates’ Attitude towards the Use of Asynchronous Online Discussion (AOD)

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Abstract: This article intended to describe the undergraduates’ attitude towards the use of asynchronous online discussion (AOD). A total of 269 undergraduates in Universiti Putra Malaysia (UPM) participated in this study. Attitudes scale consisted of 23 items with five point likert scale were used as the instrument in this study. Overall, findings of this study indicated that undergraduates have positive attitudes towards the use of AOD.

Keywords: Attitude, asynchronous online discussion (AOD), computer mediated communication (CMC)

1. Introduction

In the recent years use of Computer Mediated Communication (CMC) in higher education institutions (Ferriman, 2013; Sidhu & Embi, 2010) has increased due to the remarkable popularity of the Internet. Study shows that, students prefer to use asynchronous CMC as compare to synchronous CMC (Kocaman-Karoglu, Ozden, & Kiraz, 2011; Ali, & Joyes, 2007; Hewitt, 2005). The major shortcoming of synchronous CMC is that students are not able to partake at the same time due to the busy schedule and time restrictions (Huang & Hsiao, 2012).

Asynchronous online discussion (AOD) is described as “a text-based human-to-human communication via computer networks that provides a platform for the participants to interact with one another in exchanging ideas, insights and personal experiences” (Hew & Cheung, 2003, p. 249). The tools that supported AOD include fax, email, mailing list, calendar, survey and pools, internet bulletin, discussion boards, list-servers, newsgroups, forums, announcement, blackboard documents, wikis, blog and social networking sites [such as Facebook, Twitter, etc] (Ferriman, 2013; Huang & Hsiao, 2012; Chen, 2012; Ali, Ali, Abdullah & Ayub, 2008; Erlin, Yusof & Rahman, 2007; Roblyer, 2006; Rainsbury & Malcolm, 2003).

2. Literature Review

An individual’ attitude plays an important role in directing and shaping individual’s behaviour in daily live (Aydin, 2012; Schafer & Tait, 1986). An individual’s attitudes can be influenced by mood and emotion (Ajzen & Fishbein, 2000). Ajzen and Fishbein (2000) have described attitude as favourable or unfavourable individual’s degree of action with respect to a psychological object. The successful implementation of any educational technology utilization in teaching and learning process is also influenced strongly on students’ positive attitudes towards the educational technology (Williams, Boyle, Molloy, Brightwell, Munro, Service, & Brown, 2011). Student’s attitudes play as a crucial role in educational technology usage and are not subject to change unless it causes ineffectiveness (Onen, 2012). Therefore, it is valuable to have knowledge regarding students’ attitudes towards the use of educational technology in directing better understanding pertaining students’ communication behaviour in online learning (Aydin, 2012). Additionally, Williams et al. (2011) have stated that understanding students’ attitudes towards educational technology would enable to facilitate the development and improvement of appropriate educational strategies and initiatives.

The theory that guided this study is Technology Acceptance Model (TAM) developed by Davis in 1986 (Davis, Bagozzi, & Warshaw, 1989). The TAM was formulated to predict computer usage
across a broad range of computer based technologies via five variables namely behavioural intention, attitude toward using, perceived usefulness, perceived ease of use, and external variables (Davis et al., 1989). The TAM obtained various empirical supports for being one of a powerful and parsimonious in predicting technology acceptance and adoption (Wong, Osman, Choo & Rahman, 2013).

In this study, one of the elements in TAM that has been adopted is the attitudes variable. The attitude factor has been the spotlight of numerous studies in the use of educational technology (Abedalaziz, Jamaluddin, & Chin, 2013; Teo, 2012; Edmunds, Thrope & Conole, 2012; Aydin, 2012; Williams et al., 2011). The previous studies have shown that students’ positive attitudes towards educational technology determine the successful utilization of the educational technology (Abedalaziz et al., 2013; Teo, 2012; Edmunds et al., 2012; Aydin, 2012; Williams et al., 2011). According to Teo (2012), students’ attitude is the most dominant determinant of behavioural intention. He has recommended that, if the educational technology unable to fulfil students’ need, they would decline to use it. Thus, it can be concluded that the undergraduates’ use of AOD will be significantly influenced by their own attitude towards AOD.

3. Objective

The main purpose of this study was to determine undergraduates’ attitude towards the use of asynchronous online discussion (AOD).

4. Research Methodology

4.1 Research Design

This study was based on quantitative research. According to Cohen, Manion and Morrison (2007) quantitative approach is a powerful research suitable for larger and smaller scale research, such as case studies, action research, correlational research and experiments. Thus, a descriptive research design was employed as it was believed to be the pertinent approach in order to determine the undergraduates’ attitude towards the use of AOD.

4.2 Population and Sample

This study was carried out in the first semester 2012/2013 in Universiti Putra Malaysia (UPM) Serdang campus. Four faculties participated in this study and they were selected using a fishbowl random sampling technique where three faculties from the science stream (Faculty of Medicine and Health Sciences, Faculty of Science, and Faculty of Computer Science and Information Technology) and one faculty from the social science stream (Faculty of Human Ecology). These faculties represented the ratio of faculties in UPM where 12 sciences faculties and only four social sciences faculties (12:4). The total population for this study was 2770 undergraduates, where only the third semester undergraduates and above were selected as the target population. This was because they were assumed to be exposed to online learning for at least two semesters.

This study primarily applied the five-point Likert scale to measure continuous data and Cochran’s formula was employed in order to identify the desired sample size (Bartlett, Kotrlik & Higgins, 2001). As a result, the required sample size was 244. Oversampling technique was applied to overcome the sampling error (Cochran, 1997). As recommended by Cohen et al. (2007), this would able to increase up to 50% of sample size because the response rate is usually fewer than the target sample. Thus, the drawn sample size after oversampling was 366. A total of 370 questionnaires were printed and distributed among undergraduates, however only 313 were returned. About 44 questionnaires were excluded due to the missing values and extreme outlier. Hence, a total of 269 cases were valid to be analyzed.

4.3 Instrumentation

This study used attitude scale developed by Albirini (2006) which had acceptable validity and had been commonly used by others researcher all over the world. The researcher acquired Albirini’s permission
to adapt, modify and translate the instrument. The attitude scale consisted of 23 items and used a five point Likert scale. The questionnaire was administered in English and Malay language as the undergraduates were found to use both languages as the medium of teaching and learning.

4.4 Validity and Reliability

The content validity was established to guarantee that each item used was accurate for the research and the subjects (Gay, Mills & Airasian, 2009). After the content validity process had been verified and established by three educational technology experts, the questionnaire was retained for the pilot test in assessment of the reliability among 40 undergraduates in UPM. All of the respondents were a third semester student and they were randomly selected and were not involved in the actual study. The tolerable Cronbach’s alpha value of a scale instrument must above 0.70 (Pallant, 2001). The value of internal reliability obtained based on pilot study (N=40) was 0.86, while the internal reliability obtained based on the actual study (N=269) was 0.90. Therefore, this instrument had found to have an excellent internal consistency because all alpha level was greater than 0.70.

4.5 Data Analysis

SPSS 19.0 statistical package was used in order to analyze the data obtained from this study. Descriptive statistics (frequency, percentage, mean and standard deviation) were used for data interpretation.

5. Results

The undergraduates’ attitude towards the use of AOD was measured using the Attitude Scale consisting 23 items of five point Likert scales. The descriptive analysis revealed that the mean score obtained for this attitude construct was 3.74 with standard deviation 0.49. Since, the mean score obtained was larger than the cut-off point of 3, the overall undergraduates’ attitude towards the use of AOD considered as positive.

Based on the information presented in Table 1, most of the undergraduates stated that the AOD was an efficient means of getting information (M=4.09, SD=0.64). They were also agreed that the AOD was a means of getting information faster (M=4.07, SD=0.62). The majority of the undergraduates glad that the AOD was applicable in their lesson (M=3.97, SD=0.76). Moreover, most of the undergraduates stated that learning about the AOD is not a waste of time (M=3.91, SD=1.00). Additionally, the undergraduates reported that using the AOD could enhance their’ learning (M=3.86, SD=0.70).

Furthermore, the majority of the undergraduates would like to learn more about the AOD (M=3.84, SD=0.66). The majority of undergraduates reported that using the AOD would be able to save more time (M=3.83, SD=0.74). The undergraduates also stated that using the AOD made them feel comfortable (M=3.82, SD=1.05). Most of the undergraduates reported that using the AOD was enjoyable (M=3.81, SD=0.71). In addition, most of the undergraduates stated that students must use the AOD in all courses (M=3.71, SD=0.95).

6. Discussion

In general, the undergraduates showed positive attitudes towards the use of AOD in learning process. This finding is congruence with some previous study conducted at higher education institutions which stated that students have an overall positive attitude towards using computer technology for instance the Internet and online communication (Abedalaziz et al, 2013; Aydin, 2012; Onen, 2012; Teo, 2012). According to Aydin (2012), students view asynchronous CMC as part and parcel in their social lives, as a technology are able to facilitate their lives because asynchronous CMC provides them with the opportunity to communicate anytime, anywhere and at their own convenience.
Table 1: Percentage of the undergraduates’ attitude towards the use of AOD.

<table>
<thead>
<tr>
<th>Items</th>
<th>Percentage (%)</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1. Using the AOD does not scare me at all.</td>
<td>1.9</td>
<td>7.4</td>
<td>19.3</td>
</tr>
<tr>
<td>2. Using the AOD makes me feel uncomfortable.*</td>
<td>2.6</td>
<td>11.2</td>
<td>16.4</td>
</tr>
<tr>
<td>3. I am glad that AOD is applicable in my lesson.</td>
<td>0.4</td>
<td>3.0</td>
<td>19.3</td>
</tr>
<tr>
<td>4. I do not like to interact with others using AOD.*</td>
<td>3.0</td>
<td>10.8</td>
<td>22.3</td>
</tr>
<tr>
<td>5. Using the AOD is enjoyable.</td>
<td>0.0</td>
<td>2.6</td>
<td>28.3</td>
</tr>
<tr>
<td>6. I dislike using the AOD in lessons.*</td>
<td>2.6</td>
<td>8.9</td>
<td>22.3</td>
</tr>
<tr>
<td>7. Using the AOD saves more times.</td>
<td>0.4</td>
<td>3.3</td>
<td>22.7</td>
</tr>
<tr>
<td>8. Using the AOD saves effort.</td>
<td>1.1</td>
<td>3.7</td>
<td>24.5</td>
</tr>
<tr>
<td>9. Universities would be a better place without AOD.*</td>
<td>2.2</td>
<td>12.3</td>
<td>19.3</td>
</tr>
<tr>
<td>10. Students must use the AOD in all courses.</td>
<td>1.9</td>
<td>5.6</td>
<td>36.1</td>
</tr>
<tr>
<td>11. Learning about AOD is a waste of time.*</td>
<td>0.7</td>
<td>10.4</td>
<td>19.3</td>
</tr>
<tr>
<td>12. AOD would motivate me to study more.</td>
<td>1.1</td>
<td>4.8</td>
<td>32.7</td>
</tr>
<tr>
<td>13. AOD is a means of getting information faster.</td>
<td>0.0</td>
<td>1.5</td>
<td>11.2</td>
</tr>
<tr>
<td>14. AOD is an efficient means of getting information</td>
<td>0.7</td>
<td>1.1</td>
<td>8.6</td>
</tr>
<tr>
<td>15. I do not think I would ever need the AOD in my classroom.*</td>
<td>2.2</td>
<td>14.9</td>
<td>24.5</td>
</tr>
<tr>
<td>16. AOD can enhance students’ learning.</td>
<td>0.4</td>
<td>2.2</td>
<td>23.4</td>
</tr>
<tr>
<td>17. AOD does more harm than good.*</td>
<td>0.7</td>
<td>13.8</td>
<td>24.5</td>
</tr>
<tr>
<td>18. I would rather communicate face to face than using AOD.*</td>
<td>9.7</td>
<td>40.9</td>
<td>39.4</td>
</tr>
<tr>
<td>19. If I had enough time, I would use AOD.</td>
<td>0.0</td>
<td>4.5</td>
<td>26.4</td>
</tr>
<tr>
<td>20. I would avoid using AOD as much as possible.*</td>
<td>1.5</td>
<td>10.4</td>
<td>24.2</td>
</tr>
<tr>
<td>21. I would like to learn more about AOD.</td>
<td>0.0</td>
<td>1.5</td>
<td>26.0</td>
</tr>
<tr>
<td>22. I have no intention to use the AOD in the near future.*</td>
<td>1.1</td>
<td>12.6</td>
<td>22.7</td>
</tr>
<tr>
<td>23. I only use the AOD at my university when I am told to.*</td>
<td>4.8</td>
<td>16.7</td>
<td>37.5</td>
</tr>
</tbody>
</table>

*Items for which scoring is reversed.
1= Strongly Disagree; 2= Disagree; 3= Neutral; 4= Agree; 5=Strongly Agree

The findings also consistent with one of the 11 shifts of Malaysian educational system transformation which is leverage ICT to expand quality education across Malaysia (Ministry of Education Malaysia, 2013). The overall positive attitudes towards the use of AOD in learning process could be attributed to the availability and accessibility of computer and Internet technology provided by Universiti Putra Malaysia. Moreover, there were two possible rationales of high positive attitudes towards the use of AOD in learning process namely the high usage of computer and its applications in teaching instruction and student assignments (Abedalaziz et al., 2013).

The results also revealed that majority of the undergraduates were comfortable, approximating and enjoy using the AOD in their lessons. Additionally, majority of the undergraduates also stated that they glad the AOD was applicable in their lessons. The findings were similar with prior studies (Alrushiedat & Olfman, 2013; Kocaman-Karoglu, Ozden, & Kiraz, 2011; Courtney & King, 2009) where all of them noted that majority of students like to use the AOD and thought the AOD was extremely useful.

Additionally, majority of the undergraduates reported that they would like to learn more about the AOD and recommended other students to use the AOD in all courses. In addition, majority of the undergraduates intended to use the AOD in the future and would not avoid in using the AOD in their lesson. There were few reasons that may underlie the obtained results. The undergraduates may felt that traditional class discussions were short and only limited to few students (Alrushiedat & Olfman, 2013; Bassett, 2011), while the AOD was more comprehensive, lively and gave them an equal chance to participate actively in class (Sidhu & Embi, 2010; Shana, 2009). Thus, they can explicitly express their
ideas and opinions in writing (Ng, Cheung & Hew, 2012; Bassett, 2011; Kocaman-Karoglu et al., 2011; Sidhu & Embi, 2010; Cheung, Hew & Ng, 2008). Furthermore, findings revealed that the undergraduates reported that using the AOD would be capable in saving more times and effort. The majority of the undergraduates agreed that AOD was an efficient means of getting information faster. Moreover, the undergraduates also stated that using the AOD would motivate them to engage more in learning and enhance their learning achievement. The results imply that the undergraduates have realized the impact of the use of AOD in their learning process. These results were consistent with those of others studies and reported that the AOD facilitates students improve their learning skills (Kocaman-Karoglu et al., 2011; Sidhu & Embi, 2010; Shana, 2009) and perform better in academic (Alrushiedat & Olfman, 2013; Kocaman-Karoglu et al., 2011; Shana, 2009).

6. Conclusion

Overall, the undergraduates have positive attitudes in using AOD. On that noted, this study has provided a significant data in the body of knowledge particularly in online learning pedagogy at the higher education institutions in Malaysia. Results from this study may also help educational authorities and universities by suggesting issues that may influence undergraduates’ attitudes towards the use of AOD in learning process. The findings of this research will also able to contribute to educational technology implementation by Universiti Putra Malaysia and facilitate in implementing successful frameworks of embedding online learning in higher educational institution system. The decision makers can take the necessary steps to encourage the positive attitudes in order to improve the use of AOD among undergraduates. The research data enable lecturers to use suitable type of AOD tools, strategies and technique in teaching and learning process.

Acknowledgements

The authors would like to acknowledge the Universiti Putra Malaysia’s undergraduates from the participating faculties who took part in the study.

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University Teachers’ Needs of Support for Designing and Preparation of Courses: A Focus on Differences by Academic Discipline and Rank

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bCenter for Information Technology in Education, Tohoku University, Japan
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Abstract: In order to clarify the specific support needs of university teachers for the design and preparation of courses, and to incorporate these fundamental data into developing effective and practical programs or ICT tools for Professional Development, this paper analyses differences according to the academic ranks and disciplines of survey respondents. The authors conducted a university-wide survey in 2012 targeting faculty members at Tohoku University. Results show that the need for orientation sessions, seminars, and counseling is higher among teachers in their early career phases, such as for Lecturers and Assistant Professors. On the other hand, teachers regardless of their academic rank or discipline have certain needs such as “Digitization of teaching materials” and “Classroom observations of other teachers’ lessons (by video)”. Although the percentage is not high, the need for “Reflection or reviewing of own teaching” is considered common across all academic ranks and disciplines. In contrast, a need for “Classroom observations of other teachers’ lesson (by video)” is less needed by Professors. It is expected that Professors might already have enough experience in teaching and prefer learning from their own practice rather than from others in seminars or teaching observations. These differences are considered to have a relation to a teacher’s approach to course design. It is necessary to consider these differences and commonalities among teachers when we develop practical support systems or programs for university teachers.

Keywords: professional development, faculty development, teacher needs, teacher support

1. Introduction

Under pressure from policy makers and society, universities are engaged in coordinated efforts for improving the quality of teaching, which is better known as Professional Development (or Faculty Development). Usually, a Professional Development program is offered by a centralized teaching and learning center, or by individual departments in universities. However, it has been indicated that priorities among coordinators of such development programs focus more on meeting individual faculty needs rather than responding to the critical needs of the institution (Sorcinelli et al., 2006). Solving this problem, Gillespie et al. (2010) noted the importance of incorporating institutional research and data on teaching and learning. In order to develop and offer effective and practical programs or ICT tools for Professional Development, it is important to know how university teachers design their courses as well as their actual needs for support on teaching improvement.

To obtain fundamental data about the above points, the authors conducted a university-wide survey in 2012 targeting faculty members at Tohoku University, Japan. In the previous preliminary report (Konno et al. 2013), the overall trend and situation of teachers’ approaches were reported. Also, the report indicated that the teachers’ approaches and support needs might vary between academic disciplines.

Several studies have indicated that there are differences between disciplines which impact on research activities (for example, Sparks, 2005). Despite the acknowledged importance of teaching, and the large body of research on teaching, the role of disciplines in shaping teaching is a relatively new focus (Neumann, 2001). The issue of whether, and how, teaching varies across the various disciplines has received limited attention (Hativa et al., 1995, Neumann 2001). Smeby (1996) conducted a survey
which targeted Norwegian universities and clarified that there are significant field differences in the time spent on teaching and preparation and in the distribution of time between different types of teaching and learning levels.

In order to clarify the details of university teachers’ support needs in designing and preparing courses, and to incorporate this fundamental data into the program development process, this paper analyzed the data from the Tohoku University survey from the perspective of the respondents’ academic rank (academic appointment) and discipline.

2. Method

2.1 Survey Administration

The authors conducted a university-wide anonymous survey in March 2012. A questionnaire was distributed via inter-university mail to all full-time teachers at Tohoku University, excluding sessional or part-time teachers. Twenty-four questions regarding course design were asked.

2.2 Survey Analysis

In this paper, we focus on answers to one question from the survey: “What kind of support would you like to use for your course design and class preparation?” When answering the above question, we asked the teachers to choose and answer about one course which they taught during the 2011 academic year at Tohoku University. Multiple answers were allowed. The answers were analyzed using chi-square ($\chi^2$) tests, in terms of differences among different academic rank and discipline.

3. Findings

3.1 Survey Respondents.

The survey response rate was 47.4% (N=1290). 153 teachers out of 1290 declined to answer the survey because they had never taught in the University. Therefore a valid response rate for this survey was 41.8% (N=1137) (Center for the Advancement of Higher Education, Tohoku University, 2014). Table 1 provides the academic rank of the respondents. According to the official records of Tohoku University as of May 1st 2011, the proportions of faculty academic ranks were: Professor (30.1%), Associate Professor (25.0%), Lecturer (5.4%), and Assistant Professor (39.5%) (Tohoku University, 2011). Hence, the proportion of the respondents’ academic rank of this survey has approximate correspondence to the actual proportions of Tohoku University’s personnel.

Table 1: Respondents’ academic ranks.

<table>
<thead>
<tr>
<th>Academic Rank</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor</td>
<td>369</td>
<td>32.5</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>310</td>
<td>27.3</td>
</tr>
<tr>
<td>Lecturer</td>
<td>85</td>
<td>7.5</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>362</td>
<td>31.8</td>
</tr>
<tr>
<td>Other</td>
<td>11</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1137</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 2: Respondents’ academic disciplines.

<table>
<thead>
<tr>
<th>Disciplines</th>
<th>Number</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities</td>
<td>65</td>
<td>5.7%</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>77</td>
<td>6.8%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>61</td>
<td>5.4%</td>
</tr>
<tr>
<td>Sciences</td>
<td>333</td>
<td>29.3%</td>
</tr>
<tr>
<td>Engineering</td>
<td>215</td>
<td>18.9%</td>
</tr>
<tr>
<td>MDP</td>
<td>372</td>
<td>32.7%</td>
</tr>
<tr>
<td>Other/No response</td>
<td>14</td>
<td>1.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1137</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 3: Respondents’ academic ranks and disciplines.

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<thead>
<tr>
<th>Discipline</th>
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<th>Associate Professor</th>
<th>Lecturer</th>
<th>Assistant Professor</th>
<th>Total</th>
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</thead>
<tbody>
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<td>24</td>
<td>5</td>
<td>10</td>
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<td>91</td>
<td>61</td>
<td>60</td>
<td>157</td>
<td>371</td>
</tr>
</tbody>
</table>

Table 2 provides the academic disciplines of the respondents. An approximate estimate of the proportion of each discipline in Tohoku University based on the published numbers of each faculty (eliminating inter-disciplinary fields and institutions) for 2011 was: Humanities (6.4%), Social Sciences (10.4%), Agriculture (7.8%), Sciences (18.2%), Engineering (24.3%), and Medicine, Dentistry and Pharmacology (24.3%) (Tohoku University, 2011). In this survey, we have more respondents from Sciences and Medicine, Dentistry and Pharmacology (MDP) compared to actual proportions of faculty members in Tohoku University.

Table 3 shows a breakdown of respondents’ disciplines according to their academic rank. 72.3% of Lecturer respondents were from MDP. It is necessary to note this ratio when we look into the results of the analysis by respondents’ academic ranks.

3.2 Overall Trend of the Support Needs for University Teachers

Figure 1 shows responses to the question: “What kind of support would you like to use for your course design and lesson preparation?”

Although 23% of teachers answered that they need nothing in particular, more than 20% of teachers responded that they would like to access supports such as “11. Classroom observations of other teachers’ lesson (by video)” (25.4%); “4. Digitization of teaching materials” (24.8%); and “1. Orientation session by university or department about teaching” (23.6%) (Konno et al. 2013).

3.3 Differences between Academic Ranks

Figure 2 provides the results as organized by the teachers’ academic ranks.

More Professors (31.7%) answered that they needed “13. Nothing in particular” for any support, compared to 15.4% of Lecturers ($\chi^2(3)=15.348$, significant at $p<.01$). On the other hand, more Professors (7.8%) selected “14. Other” and described concrete ideas of support as other options.
(χ²(3)=14.648, p<.05). “1. Orientation session by university or department about teaching” is more needed by early career teachers (χ²(3)=19.681, p<.001). “2. Seminar about designing syllabus” is higher among Lecturers (26.9%), while less needed among Professors (3.9%) (χ²(3)=44.069, p<.001). Also, the need for “3. Seminar about teaching and assessment” is higher among Lecturers (34.6%) (χ²(3)=15.877, p<.01).

The needs for counseling, such as “5. Counseling by former lecturer” (χ²(3)=67.703, p<.001), “7. Counseling by senior faculty members” (χ²(3)=42.743, p<.001), and “8. Counseling by supervisors” (χ²(3)=25.929, p<.001), as well as a need for “9. Gathering of newly appointed teachers” (χ²(3)=16.947, p<.01) are more needed by early career academics. Regarding the need for “6. Counseling by colleagues”, however, there was no significant difference between teachers’ academic ranks (χ²(3)=5.595).

A need for “10. Individual consultations by professional staff” is higher among Lecturers (χ²(3)=9.973, p<.05); while “11. Classroom observations of other teachers’ lesson (by video)” is more needed by early career academics (χ²(3)=10.451, p<.05). Although there were significant differences between academic rank regarding needs of support on 11 options out of 14, the needs for “4. Digitization of teaching materials (χ²(3)=2.368), “6. Counseling by colleagues (χ²(3)=5.595)” and “12. Reflection or reviewing of own teaching (χ²(3)=2.890)” had no significant differences. Especially, “4. Digitization of teaching materials” had a relatively high need among teachers: Professor (26.9%), Associate Professor (23.6%), Lecturer (19.2%), and Assistant Professor (24.4%). In other words, support for digitization of teaching materials is needed regardless of teachers’ academic ranks.

3.4 Differences between Academic Disciplines

Figure 3 provides the results as organized by disciplines.

The need for “2. Seminar about designing syllabus” is higher in Medicine, Dentistry and Pharmacology (16.1%) (χ²(5)=26.014, p<.001), and low in Sciences (4.1%). “5. Counseling by former lecturer” is more needed by Sciences (14.5%) and Engineering (12.8%), compared to Humanities (3.4%) and Social Sciences (4.1%) (χ²(5)=11.766, p<.05). Also a need for “6. Counseling by colleagues” is higher in Engineering (19.7%) and Humanities (23.7%), and low in Agriculture (5.3%) and Medicine, Dentistry and Pharmacology (10.2%) (χ²(5)=20.070, p<.01). A need for “8. Counseling by supervisors” is higher in Medicine, Dentistry and Pharmacology (7.4%) (χ²(5)=18.865, p<.01). “11. Classroom observation of other teachers’ lesson (by video)” is more needed in Medicine, Dentistry and Pharmacology (30.7%), Humanities (32.2%), and Agriculture (31.6%), compared to Sciences (19.7%) (χ²(5)=14.164, p<.05).


4. Discussion

The results show the differences and commonalities of support needs according to academic rank and disciplines. Relatively popular support needs were: “11. Classroom observations of other teachers’ lesson (by video)” (25.4%); “4. Digitization of teaching materials” (24.8%); “1. Orientation session by university or department about teaching” (23.6%); and “3. Seminar about teaching and assessment” (21.8%).

First of all, overall trends of support needs show that early career faculty express more needs compared to Professors. However, a need for “6. Counseling by colleagues” (in total: 15.9%, Professor: 12.3%) has no significant difference in academic ranks. Thus, opportunities for sharing their own issues and situation about teaching with colleagues have a common demand regardless of academic rank. From the point of view of academic disciplines, counseling by colleagues is more needed in Engineering, Agriculture, and Humanities.
A need for "Reflection or reviewing of own teaching" showed no significant difference in academic ranks (in total: 16.0%, Professor: 17.4%) or disciplines. Although the percentage is not high, it is considered that the need for "Reflection or reviewing of own teaching" commonly exists regardless of academic ranks and disciplines. On the other hand, a need for "Classroom observations of other..."
teachers’ lesson (by video)” is less needed by Professors. It is expected that Professors might recognize they already have enough experience in teaching; and therefore prefer learning from their own practice rather than from others in seminars or teaching observations.

A need for “Digitization of teaching materials” also has no significant difference among academic ranks (in total: 24.8%, Professor: 26.9%) or disciplines. This means that “Digitization of teaching materials” is commonly needed by teachers, regardless of academic rank or discipline. As for the specific content of the digitization of teaching materials, the following are expected: creating PowerPoint slides, creating audio-visual materials, or changing analog materials into computer friendly materials, etc. To clarify the details of teachers’ demands, an additional survey or interview is needed.

5. Conclusion

In order to clarify the details of university teachers’ needs of support for designing and preparation of courses, and to incorporate this fundamental data into developing effective and practical programs or ICT tools for Professional Development, this paper analyzed differences by academic disciplines and rank of respondents. From the results of the analysis, we found that the support needs of university teachers for designing courses are different according to academic rank and discipline.

Especially, there are certain needs of “Digitization of teaching materials” and “Classroom observations of other teachers’ lessons (by video)” regardless of teachers’ academic rank or disciplines. It would be useful to consider the differences and commonalities when developing support systems or training programs for those teachers.

As a future work, we need to undertake a more detailed analysis of the results including other scopes of statistical data analysis, such as the respondents’ age groups and the types of courses teachers answered about. In addition, in order to clarify the reason and background for the differences in their support needs, we are planning to undertake an interview process.

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References

Using a PBL Authoring Tool to Train Teachers in Designing an Online PBL Unit

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Abstract: Problem-based learning (PBL) is proposed as one of the most well-known alternatives to subject-based learning in educating graduates to become independent workers, critical thinkers, problem solvers, lifelong learners, and team workers. However, the PBL practice is still far from widespread. One of serious impediments to PBL’s diffusion in education is that teachers have difficulties in transforming a subject-based course into a problem-driven course. In addition, teachers lack the necessary skills to make informed judgments and decisions about how to use technologies in their PBL practices. The purpose of this research is to support teachers in developing an online PBL unit. Based on schema theory we developed a PBL scripting language and an associated PBL authoring tool. The tool was developed for teachers to represent, communicate, and reuse their PBL course/lesson plans implementing in technology-enhanced learning environments. It is assumed that it can also be used as a means to educate teachers who may be not familiar with PBL to learn PBL design and to develop an online PBL unit. Through conducting an experiment we found that the PBL authoring tool can facilitate teachers to make informed decisions in their design practice through following a formal design method. Most participants of the experiment thought that the tool is useful to design an online PBL unit and easy to learn.

Keywords: Teacher training, Problem-based learning (PBL), Learning Design, Schema theory, PBL scripting language, online PBL unit

1. Introduction

A growing urgency to prepare students for 21st century challenges has many educators looking for new instructional approaches. Problem-based learning (PBL) is proposed as one of the most well-known alternatives to subject-based learning. In PBL, through learning to collect information, analyze data, develop hypotheses and apply strong deductive reasoning to the problem at hand, students acquire a deep understanding of knowledge and lifelong learning skills (Hmelo & Eberbach, 2012). However, the PBL practice is still far from widespread. One of serious impediments to PBL’s diffusion in education is that teachers, with few exceptions, do not have the expertise to transform a lecture-driven course into a problem-driven course because they are well-versed in teaching and lecturing, but have a difficult time changing their role to that of a facilitator who guides students but does not give the answers (Ertmer & Simons, 2006). In addition, many information and communication technologies (ICT) tools have been used to support the implementation of PBL such as accessing learning resources and fostering collaboration (Kaldoudi, et. al. 2008). Teachers normally lack the necessary expertise to make informed judgments and decisions about how to incorporate contemporary tools and resources to maximize learning in context. They may lack experiences to design and conduct a PBL course integrating digital tools and resources to promote student learning and creativity.

The shift to PBL creates an important question for teachers: How do I design a PBL course to meet goals for both content mastery and 21st century learning? The research work described in this paper is to educate teachers in the development of technology-enhanced PBL courses through adopting the approach of learning by design (Koehler & Mishra, 2005). We adopt this approach to engage teachers in meaningful design problems in an attempt to facilitate their adoption of PBL practices and to improve their use of technology. However, learning to design an online PBL unit is a difficult and
time-consuming task. To facilitate teachers in the design of an online PBL unit, we developed a PBL authoring tool. Our assumption is that teachers using the PBL authoring tool can easily acquire relevant knowledge about how to develop an online PBL unit as they are guided to make informed decisions.

2. Learning Design and PBL Scripting Language

Learning design has emerged as a distinct field of research, which is concerned with the development of methods, tools, and resources for helping designers in their design process (Koper, 2001; Beetham & Sharpe, 2007; Lockyer et. al., 2008). It focuses on planning, structuring and sequencing learning activities and designing learning context and environment with technical support for knowledge construction from the perspectives of learners. It also denotes the result or product of the design process, a computational description of a teaching-learning process that may happen in a lesson or a course. Learning design aims at providing a means to represent and communicate the designs of learning activities so that they can be shared among practitioners at design-time. Furthermore, the learning designs can serve as a means to orchestrate and scaffold teaching and learning practice at run-time (Koper & Tattersall, 2005; Miao et. al., 2005).

Analogous to the music notation that contains enough information to convey musical ideas from one person to another over time and space, researchers in the field of learning design tried to develop a notational system for describing and sharing learning design ideas. Many learning design languages and associated tools have been developed in the past decade such as IMS-LD (IMS-LD homepage), LAMS (Dalziel 2000), and CompendiumLD (Conole et. al. 2008). These learning design languages were developed for describing a wide range of pedagogical strategies. However, the practitioner has difficulties representing complex learning activities using languages like IMS-LD (Miao & Koper, 2007), because the vocabularies of these languages are pedagogy-irrelevant and technology-oriented terms such as “activity”, “property”, “learning object”, and “data-type”. They provide less or even no vocabularies and guidance to represent and implement specific pedagogic strategies such as problem-based learning. In order to support the design and sharing of PBL practices, we developed a PBL scripting language. The framework that we used to define the PBL scripting language is theoretically based on schema theory (Schank 1977). According to schema theory, generalized knowledge about a list of the characteristic events involved in a common routine is called a script (Schank, 1977). Scripts can be used to organize procedural knowledge, to assist recall, to guide behavior, to predict likely happenings, and to help individuals make sense of our current experiences. People know how to behave and what to expect in particular situations by using scripts. Scripts are mental structures representing the person’s knowledge about objects, people, or situations. As shown in Figure 1, the process of eating at a restaurant can be described as a script that is divided into five ‘scenes’. When a scene finishes, another scene may start. In this restaurant script, there are three roles: consumer, waiter, and chef. The script embodies knowledge about how people in a particular role (e.g. waiter, or customer) are expected to behave in each scene. For example, it is expected that a chef prepares the food that the customer ordered and a waiter passes the food to the customer in the serving scene. After being served, the customer should eat the food in the eating scene. Such expected behaviors are called behavior rules. A behavior rule combines a role, an action, an object, and others such as tool and resource. In order to represent procedural knowledge in restraint, we can define vocabularies and relevant rules that can be used to specify various restaurant scripts such as those used in McDonalds or a buffet style restaurant.

![Figure 1. A typical restraint script](image)

In the light of schema theory, we developed a PBL scripting language through analyzing and summarizing well-known PBL models. Using the language, we can represent a PBL unit as a PBL script – a computational description of a PBL process. A PBL script has properties such as title, learning objectives, prerequisites, description, driving problem, target learners, and estimated duration. It consists of a set of phases that can be executed in sequence (as the default structure), in parallel, in branch or in loop. When designing a phase, a teacher should choose one or more phase types from the

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following list: preparation, problem engagement, problem definition, idea generation, learning issue identification, plan, information sharing, investigation, reasoning, problem resolution, evaluation, application, reflection, and report. In addition, associated phase types such as facilitation, collaboration, basic cognition, and assessment will be associated with any given phase. In a given phase, only certain types of activities are suggested for completion. For example, in the phase problem engagement the following four types of activities are suggested: present case/situation/scenario, observe phenomenon, introduce problem trigger, and clarify concept. A type of activity may produce a certain type of artifact. The artifact types of this phase are case, scenario, situation, phenomenon, and observation. Another example is a phase with a type of learning issue identification. It can contain the following activity types: identify learning issue, formulate learning issue, organize learning issue, and identify knowledge need. The artifact types of this phase type are learning issue and learning need. After the teacher defines a phase through choosing one or multiple phase types, the user can further specify the activity structure within the phase in details.

Each phase consists of one or several activities that may be performed in sequence (as the default structure as well), in parallel, in branch, or in loop. Various process structures can be specified using arrows. When designing an activity, one can only choose an activity type from the types specified by the chosen phase types. One can specify an activity by assigning values to the activity properties such as title, learning objectives, description, work mode, starting condition, and completion condition. A choice of a certain property such as time limit as a choice of the completion condition will need further specification. In this case, one needs to specify how many hours to perform this activity. In addition, the constraints between the type of artifact and the type of activity are specified as well. For example, in the phase with a chosen type problem engagement, an activity present a case can be arranged. A learning resource with a type case can be used as an input of the activity. In a phase with a type of learning issue identification, one can arrange an activity by choosing an activity type formulate learning issue and define an artifact with a type of learning issue as an output. It also enables a detail design of an activity by defining the relations with actors, learning resources, and tools. For example, the teacher can assign the actor of activity with a type of formulate learning issue as a learner, a facilitator, a group of learners, all groups in a class, or all learners in a class. If the actor of an activity is assigned to multiple people, it is needed to further specify whether they should perform the activity individually, separately, or collaboratively. If choosing collaboratively, one has to further choose communicative or/and collaborative tools such as chat-room and whiteboard.

3. Using a PBL Authoring Tool to Design an Online PBL Unit

Planning an online PBL unit can be daunting, especially for the novice. It includes many tasks such as choosing standards and learning objectives, defining a driving problem, preparing resources, grouping students, arranging learning environments, structuring and sequencing learning activities, choosing assessment rubrics and criteria, and exploiting technologies. In order to facilitate the design of an online PBL unit, we developed a web-based graphical PBL authoring tool, called PLATE Workbench. Rather than using pedagogy-irrelevant constructs provided by IMS-LD authoring tools such as Re-Course (Griffithsa, et al. 2009) and Prolix OpenGLM (Neumann and Oberhuemer, 2009), one can use the vocabularies and rules specified by the PBL scripting language. The tool provides guidance and restrictions for the teacher to develop an online PBL unit as a PBL script. The user of the tool, for example, a teacher will be guided to make informed decisions. The user interface of the tool consists of five parts. The menu bar on the top lists basic function and the state bar on the bottom indicates the current edit state. The central area contains the file manager (on the left), the graphic edit space (in the middle), and the property edit panel (on the right). Figure 2 provides a screenshot of the tool to edit a PBL script in the activity-level. The tool enables the teacher to define activities by dragging and dropping an activity node. The type of the activity can be defined by choosing one from a list of activity types that are specified in the selected phase types. The activity can be further defined by assigning values of attributes and by connecting with actor nodes, resource nodes, tool nodes, and artifact nodes. The specified relations between concepts (e.g., which type of activity can produce which type of artifact using which type of tool) within the PBL scripting language will be used as constraints to guide and restrict the construction of the diagram. Detail description of the tool and the technical implementation of the tool can be seen in (Wang, et. al. 2014).
4. A Pilot Study

In order to investigate whether the PBL authoring tool can be used to train teachers in designing an online PBL unit, we conducted a pilot study. We adopted an approach of learning by design to educate novice to acquire PBL knowledge and become familiar with the procedure and informed decisions. Here, we use the approach “learning by design” defined by Koehler and Mishra (2008) because their focus, like ours, is on teacher learning and professional development.

The pilot study was conducted in the College of Education at Qatar University. Participants in the pilot study were students from Masters in Education program and were enrolled in the end of the program internship having already completed an advanced curriculum development and design course. Most of the participants are still working as teachers in primary, preparatory and secondary schools or working in the education-relevant fields. This pilot study was arranged as a part of the course. In the course, two sessions were arranged and each session took three hours. In the first session, participants were introduced to PBL including basic PBL concepts, principles, and benefits. They were instructed how to design an online PBL module, in particular, to choose ill-structured problems, to design various process structures and to arrange individual and collaborative activities with various communicative and collaborative tools. At the end of the first session participants were briefly introduced PBL scripting language and the PBL authoring tool. Participants were required to create a user account in the PBL Workbench and to learn the tool by using a user manual and a tutorial video on their own. In the first half of the second session, participants were guided to represent a pre-designed PBL module with the PBL authoring tool step by step. In the second half of the session, participants applied what they learned through continually working on the representation of the pre-defined PBL module. During this time, some participants asked questions that were answered immediately in the class. Then the participants had to complete an assignment within ten days to create a PBL script with the tool. The assignment is centered on their authentic design problems. All participants (N = 17) completed their PBL scripts on time. Finally, participants were required to response to a questionnaire. Seventeen responses were collected and all were valid responses.

Two types of data were collected. The first type was collected from participants’ responses to the questionnaire. The questionnaire consisted of five sections: section I asked questions about participants’ background; section II addressed the computer literacy of the participants; section III contained Likert-scale questions (selecting one of five responses ranging from 1: strongly disagree to 5: strongly agree) designed for collecting participants’ attitude to the PBL authoring tool; and section IV included open questions designed for collecting participants’ feedback. The questions are mainly relevant to the ease to use and learn. According to participants’ responses to the questions in section I, it
was evident that all participants are university students and most of them are also teachers in subject areas including Arabic, math, English, health, and science. The data showed that most participants had minimal prior knowledge of PBL and that the levels of computer literacy of most participants are around an average level. The second type of data is the PBL scripts created by the participants using the PBL authoring tool and stored in the database persistently. The collected PBL scripts were assessed using three scoring rubrics: completeness, contextualization, and reasonableness. Each rubric score was ranged from 1 to 10 and the grade of a PBL script is the mean of three rubric scores. Two experts rated the students’ PBL scripts and each final score is means of scores given by the two experts.

We analyzed the relations between the scores of the students and their prior PBL knowledge and their computer literacy. It seems that the influence of computer literacy on the final score is not significant. However, prior PBL knowledge has a slight positive influence on the final score. In addition, the means of the scores of all fifteen items in section III are larger than 3.0 and the total mean of the scores is 3.6. Obviously, most participants thought that it is easy to learn to make informed decisions and the tool is easy to use to design an online PBL unit. It seems that when students think the tool is easy to use, the higher score the student received.

It is obvious that participants will definitely acquire more knowledge about how to design an online PBL unit if they learn how to use the tool and it is impossible for them to represent an online PBL unit without the tool. We directly asked open-ended questions in section III to collect students’ feedback. In relation to the usefulness of the tool in design of an online PBL unit, students wrote: “I used the PBL Workbench for a science lesson. It was suitable for the topic.” “When I used the PBL Workbench I did not have any difficulties performing a task. There were various possibilities to work with.” “I liked the way. It allows connections to be made between various elements, actors, activities, etc. I also liked that it provides clarity to every phase and activity as it asks for goals and other details.” “This tool was amazing in helping me develop the plan of how to conduct performance management at the school especially with the complications of connections to be made.” “It was new and exciting experience for me”.

In response to the question about whether it is easy to learn, students stated: “I would not say easy. It took me time to understand the thing I needed to represent my design and not sure if it’s the right thing. Yet I think with more understanding and practice it could become easy in time and the use of different design form.” “First I thought it was difficult. When I started to work with it, I found it is not that difficult, yet not an easy one to use.” “It will be easy if there are PBL model templates to help teacher to design one because it took me a long time to design a course plan.”

When answering the questions regarding the vocabularies and rules provided by the PBL scripting language, the participants reported that the vocabularies and rules were very helpful. They stated: “I think that a pre-defined list of choices facilitate the design. It saves time and efforts.” “Of course, it facilitates the work, especially for the teacher with little experience, while for expertise teachers it might limit the options, or ideas.” “I did not understand these terms until developing the course plan.” “I think they are ok and there are a lot of options to choose from which represent the basic items that are used in phase or activity. Yet I think if we could have the possibility to add our own ones ...” “From my point of view it enhances and facilitates process. It gives us an option to explore and think critically. I found it appropriate, and enough to help in PBL. On the other side, yes more options will be good addition, as ‘more sugar, more sweet’.”

In terms of aspects of the tool that were most valued, students wrote: “It provides students with greater flexibility in developing solution strategies.” “It is flexible as we are able to define as many phases as we wish and as many activities as we wish within each phase I used in my design three phases and more than 2 activity in each and it was easy.” “PBL Workbench is very flexible and helpful, easy to use, and has many multiple options that represent various forms.” “The workbench is flexible as it does not restrict us to any particular PBL model and gives room to design a PBL with as many phases we require depending upon the project.” It seems that the flexibility is an important feature of the tool.

Nevertheless, the data also revealed that students need more instruction and assistance. Some students noted that: “Lots and lots of options and information which I need more training on.” “I did develop my lesson using all of these things, it is not difficult, yet I think if there is a way to explain them more or demonstrate the different way they can be represented.” “... it could be easier if there were ready-made PBL example models the teacher can choose and change what is needed for the lessons. For example, it became similar to Microsoft publisher that have ready-made template to use and change.”
5. Conclusions

Feedback received from the participants indicated that most agreed that the PBL authoring tool is easy to learn and use for designing an online PBL unit. The tool provides guidance to make informed decisions and provides options for choosing. Participants especially emphasized that vocabularies and rules specified in the PBL scripting language make it easy to understand and design a PBL script and that the tool provides flexibility. The responses to the questions about students’ perception of the tool are basically positive and most PBL scripts created by the students were quite good.

Based on the feedback from the participants, it is important to instruct potential users on the theory of PBL and explain what are informed decisions and possible choices. Also, it is important to provide more examples and help on how to use the PBL authoring tool and to provide support to users as they develop an online PBL unit. The feedback from participants in this pilot study indicates that the PBL authoring tool will be useful for teachers to develop an online PBL unit.

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References

Using the ePortfolio System to Foster Student Self-regulated Learning

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Abstract: This research explores the effects of using ePortfolio systems on student self-regulated learning. An ePortfolio system was developed based on self-regulated learning models and the relations among ePortfolio, competency, and self-regulated learning models. Then, the ePortfolio system was used for designing a learning model for self-regulated learning. The first experiments of the model were conducted in software engineering courses at the Hoa Sen University, Vietnam. The surveys with the Motivated Strategies for Learning Questionnaire (MSLQ) were conducted at the beginning and at the end of the courses. The differences in MSLQ scales between pre- and post-tests, and between control and experimental groups were evaluated. In addition, the trace data of learning was also analyzed in order to evaluate the effects of the learning model on student self-regulated learning. The results show that students could implement and link self-regulated learning processes in the ePortfolio system. In addition, the scores of MSLQ scales improved after applying the ePortfolio-based learning model in the courses. In conclusion, the ePortfolio system and the proposed learning model had positive effects on students’ self-regulated learning skills.

Keywords: Self-regulated learning, ePortfolio system, competency measuring

1. Introduction

Self-regulated learning (SRL) is defined as a process by which learners self-regulated their learning. SRL has positive effects on learners’ achievement in and beyond school (Winne, 2005; Zimmerman, 2002). SRL skills relate to the core competencies for the 21st century (Wolters, 2010). Self-regulated learners are aware of what knowledge and skills they have and proactive in learning; they view learning as a controllable process and accept more responsibility for the results of this process (Zimmerman, 1990). Thus, fostering SRL helps students improve academic achievement and to prepare for workplace learning.

Winne (2005, 2010) claimed that learners need significant support to make SRL productive. In addition, SRL skills are teachable (Zimmerman, 2002) and may be fostered by technology enhanced learning environments (Bartolomé and Steffens, 2011; Zimmerman and Tsikalas, 2005; Devolder, Braak, and Tondeur, 2012), for example, ePortfolio platform.

In order to self-regulate learning, the learners have to know their knowledge and skills and observe learning processes. Thus, learners need support in competency assessment and performance. Research shows that ePortfolio environments provide us a potential approach to competency assessment (Gadbury-Amyot, et al., 2003; Rao, et al., 2012). Indeed, ePortfolios store learners’ achievements and the processes of reaching the achievements (JISC, 2008). In other words, ePortfolios contain and show students’ competencies and the evidence of the competencies. Thus, ePortfolios can improve the reliability and accuracy of competency assessment. In addition, instructors and learners also need environments that can support users in modeling and sharing SRL principles and implementing SRL processes.

In this research, we propose, implement, and evaluate an ePortfolio-based learning model for scaffolding student self-regulated learning in university. An ePortfolio system was developed based on SRL models and background knowledge about fostering SRL. This paper focuses on the evaluation of the use of the ePortfolio system for enhancing SRL in university.
In the next section, we summarize the research background and related work. Next, we introduce the use of the ePortfolio system for learning and study design. Then, the results of the study are represented. In the last section, we make conclusions about the effects of the system, limitations and future work.

2. Research background

2.1 Self-regulated learning (SRL)

From the process perspective, self-regulation is a self-directive process in which students convert their mental abilities to academic skills. Learning is a proactive process in which students actively participate with major responsibility and motivation (Zimmerman, 2002). Zimmerman (1998) expressed the structure and function of self-regulatory processes in terms of three cyclical phases: forethought, performance, and self-reflection. In addition, an integrated model was introduced in (Pintrich, 2004), which consists of four phases of SRL: task definition and planning, monitoring, control, and reaction and reflection; and four areas for regulation: cognition, motivation, behavior, and context.

Self-regulated learners have some skills, such as setting goals, planning strategies, monitoring performance, changing the context, managing time, evaluating methods, attributing causation results, and adapting future methods (Zimmerman, 2002). They tend to have high motivation and confidence for learning and use productive problem solving skills. These characteristics lead to relevant behavior and also a high level of achievement (Perry and Winne, 2013).

2.2 Fostering self-regulated learning

Self-regulated learning may be taught and fostered (Winne, 2005; Bartolomé and Steffens, 2011). According to Zimmerman (1998), SRL emerges from two essential sources: social and self-directed experiences. The “self” in SRL implies that learners regulate learning, however, self-regulation does not mean solo (Perry and Winne, 2013). Learners’ development of SRL depends on support from the others, for example, teachers or peers.

Scaffolding SRL includes interactions between humans and the use of technological tools, resources, and environments. SRL skills may be fostered by technology enhanced learning environments (Bartolomé and Steffens, 2011; Devolder, Braak, and Tondeur, 2012; Steffens, 2001). Zimmerman and Tsikalas (2005) argued that a key to developing self-regulated learners is linking the processes of the forethought, performance, and self-reflect phases. Thus, computer-based learning environments that support self-regulatory processes in the all three phases are more likely to support SRL better.

Bartolomé and Steffens (2011) argued that ePortfolios have a potential to foster SRL. ePortfolios allow learners to think critically and become active, independent and self-regulated learners (Abrami, et al., 2008). In addition, ePortfolio environments are tools for gathering data about events that constitute self-regulation, which are needed for fostering SRL (Winne, 2005; Zimmerman, 2008).

2.3 ePortfolios and self-regulated learning

An ePortfolio is defined as the product, created by the learner, a collection of digital artifacts articulating experiences, achievements and learning (JISC, 2008). The literature shows that ePortfolios, competency, and self-regulated learning are related to each other. For example, competency measuring affects self-regulated learning (Voorhees, 2001; Zimmerman, 2002, 2008), ePortfolios improve competency measuring (Gadbury-Amyot et al., 2003; Rao et al., 2012), and ePortfolios provide a relevant environment for practicing self-regulated learning skills (Abrami et al., 2008; Hadwin et al., 2010; Perry and Winne, 2013; Ryan and Ryan, 2012). Thus, ePortfolios improve competency measuring, demonstrating that both ePortfolios and competency measuring can foster self-regulated learning.

Competencies are the learning outcomes or the prerequisites of learning activities (Voorhees, 2001). In SRL, learners are required to self-evaluate their competencies and performances in order to
regulate their learning (Zimmerman, 2002). In addition, competency assessment allows learners to set goals, judge efficacy, and plan time and effort based on their conditions; it enhances awareness of cognition, motivation, behavior, and context; finally, it is used for self-reflection.

ePortfolios store achievements and the processes of reaching these achievements (Rao, et al., 2012). They are used to document competencies and examine how students reflected on their competency development process (Zawacki-Richter and Hanft, 2011). ePortfolios contain evidence of competencies, which includes artifacts and processes. ePortfolios help learners and external evaluators to better understand competency, and improve their ability to evaluate it.

ePortfolio systems are relevant environments for reflection and collaboration (Ryan & Ryan, 2012). Thus, an ePortfolio system is used as a platform for practicing SRL processes, which is a key to fostering SRL (Hadwin, Oshige, Gress, and Winne, 2010; Perry and Winne, 2013). With the ability to trace learning processes, ePortfolio systems allow learners to monitor learning, reflect on their learning, and make changes in learning strategies to reach the goals. Learners also can show their results to the others and cooperate with others in ePortfolio systems. These functions can promote the intrinsic motivation of learners (Vockell, 2008), which is an important factor of SRL (Pintrich, 2004; Zimmerman, 2002).

There are some issues concerning ePortfolios for self-regulated learning. Currently, no ePortfolio models for self-regulated learning are available. The literature also does not explore the relations among ePortfolios, competency, and self-regulated learning explicitly. In addition, there is a lack of reports about the impacts of such ePortfolio models on self-regulated learning. More knowledge about if or how ePortfolio systems affect student self-regulated learning is needed.

3. ePortfolio-based learning model for fostering self-regulated learning

3.1 Using the ePortfolio system for learning

Based on the above analyses and self-regulated learning models, an ePortfolio system was developed. The focus was on improving ePortfolios’ capacity for measuring competencies, capturing and sharing self-regulated learning principles, and practicing self-regulated learning processes. The system helps instructors to design programs, create program plans, observe learning activities, evaluate learning outcomes, give feedback, and hold discussions with students. Students can use the system to create learning plans, manage artifacts, monitor learning processes, evaluate task progress and learning outcomes, and reflect on feedback and results. The system is as a platform for interactions between students and instructor and among students.

The ePortfolio system is used to design learning. ePortfolio-based learning is integrated into courses, and is used as a supplement that supports formal class activities in order to foster students’ self-regulated learning skills. An evaluation form for an activity is used by students and instructors. This form appears after evaluators select a student and an activity in the plan. The first part of this form contains information about the time period, time passed, and progress of the activity. The second part lists all artifacts that are the outputs of the current activity. The goal competencies of the activity are shown in the next part, in which evaluators can check the evidence and update the levels of competencies. The last part contains the discussions that are related to the activity type of the selected activity.

3.2 Study design

The first experiments were conducted at the Hoa Sen University, Vietnam. The ePortfolio system was used in two courses: Data Structure and Algorithms (DSA), and Software Development Processes and Tools (SDPT). The DSA class had 48 first-year students, who were split into two groups (for computer lab room section), randomly one group was selected, and in the selected group voluntary students were called to use the ePortfolio system for learning. In the SDPT class, all 18 fourth year students were recommended to use the ePortfolio system for this course. The students used the ePortfolio system for learning for eight weeks.

To measure self-regulated learning, a self-reporting method with the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991) was used. MSLQ allows us to measure different
motivational components and the use of learning strategies in a given course. The MSLQ consists of 6 motivational and 9 learning strategies subscales. The 6 motivation subscales measure intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy, and test anxiety. The 9 learning strategy sub scales measure rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, effort regulation, peer learning, and help seeking. The MSLQ consists of 81 questions, which the students rated using a Likert scale from ‘‘1 not at all true of me’’ to ‘‘7 very true of me.’’

MSLQ surveys were conducted in DSA and SDPT classes in the first and the last weeks of the semester. All students were told before the survey that their participation was voluntary and not related in any way to their grades in the course. With self-report scores, to examine how the ePortfolio system affected students’ learning, the mean differences between groups were evaluated by using 2-tailed t-test with p-values of <0.05 were considered significant (Cheang, 2009).

A trace method was used for measuring and exploring students’ self-regulated learning skills by using the ePortfolio system. In previous studies (Hadwin et al., 2007; Perry and Winne, 2006; Zimmerman, 2008), the authors argued the benefits of using trace methodology to examine the dynamic perspective of self-regulated learning. The log file was analysed to examine the frequency and sequence of learning activities. Time-based analysis was used to evaluate the changes in learning over time.

3.3 Results

With the SDPT class 18 responses were collected for both the pre- and post-tests. In the DSA class, 27 responses for the pre-test and 39 responses for the post-test were received. After the post test, based on the logged data, a control group with 25 students and an experimental group with 14 students were determined. The students who did not use the ePortfolio system comprised the control group. In the control group, 13 students responded to both pre- and post-tests, while experimental group had 10 students who responded to both tests. All “reversed” items in MSLQ were reversed before scores were computed.

In the study with the SDPT course, all 18 students used the ePortfolio system. In order to evaluate the effects of the ePortfolio system on motivation and learning strategy subscales, a paired 2-tailed t-test was used to examine the differences between pre-test and post-test. The effects of the ePortfolio system on students’ motivation and use of learning strategies are now summarized. Data described in this and the remaining parts of the results section can be obtained from the authors. Positive effects were reported in thirteen scales. The data shows that the use of the ePortfolio system might contribute to significant improvement in some scales, such as metacognitive self-regulation (p=0.001), critical thinking (p=0.002), elaboration (p=0.004), and rehearsal (p=0.028). These scales relate directly to self-regulated learning (Pintrich, 2004); hence it is reasonable to argue that the system implemented had positive effects on students’ self-regulated learning skills. Although not statistically significant, improvement was seen in task value (p=0.057), and intrinsic goal orientation (p=0.069). Two scales show negative effects, but neither are significant (help seeking, p=0.452; Time/study environment management, p=0.872). Overall, MSLQ scores indicate that the system affected students’ learning in a positive manner. Therefore, the ePortfolio system promoted students’ motivation, and learning strategies.

In the study with the DSA course, the means of scales of post-tests in two groups were compared by using unpaired 2-tailed t-test. The results show that the experimental group is dominant in all scales (control mean < experimental mean, except test anxiety scale, but it means that there is less worry in the experimental group). The experimental group’s scores are significantly higher on some scales that relate to self-regulated learning, such as intrinsic goal orientation (p<0.001), effort regulation (p=0.002), self-efficacy for learning and performance (p=0.012), elaboration (p=0.023), metacognitive self-regulation (p=0.032), and task value (p=0.036). In addition, the differences in control of learning beliefs (p=0.066), organization (p=0.07), and rehearsal (p=0.095) were considered also. This comparison supports the results of the previous study in the SDPT class.

Trace data was stored in XML files, each element containing information about a performed activity, such as participants, time, which activity, and which course. A log analyzer was developed to generate frequency counts, and transition statistics. From this information, transition matrices and
transition graphs were created. In this report, only the trace data of the SDPT course was examined because all students in this class used the ePortfolio system.

Results show that students performed 50/81 of possible transition types. ‘Create plan’ is the first activity; after that, students can update plan, create artifact, or review feedback. ‘Review feedback’ and ‘evaluate activity’ are not only the most frequent activities, but also the most central activities. ‘Review feedback’ connects to the other seven activities and can be the end points of transitions that begin with the other activities. ‘Evaluate activity’ links to the other six activities in both directions. This finding indicates that by using the system, ‘review feedback’ and ‘evaluate activity’ become the central tactics of learning strategies. Students usually review feedback (for example, observe discussions, evaluations, progress, and personal plan) and evaluate task progress before and after doing other activities. This pattern of learning aligns with reflection-based learning, and supports self-regulated learning.

A transition graph is formed by nodes and directional lines; each node is represented by a type of activity with its respective percentage. In general, the more active learners, the more nodes and transitions in the transition graph. A graph can demonstrate the general trend of the classes’ use of learning strategies in a particular period. Thus, by comparing the graphs the changes in learning trends over time can be examined. The transition graph shows that the students learned quite actively because all nodes were connected to others with 50 patterns of transition. In addition, the activities and transitions in the graph are the elements that create or relate to the self-regulated learning processes (Pintrich, 2004; Zimmerman, 1998, 2002). Thus, it is argued that students’ engagement in self-regulated learning with a variety of tactics.

The changes in time-based analysis indicate that the use of the ePortfolio system for self-regulated learning was improved. The students understood more about the system and learning tactics, and they used the system for practicing self-regulated learning skills better over time. For instance, the changes explained that the students not only reviewed the feedback, when the time of use increased, they also performed other types of activity, for example, self-evaluation.

4. Conclusions

In this research the relations among ePortfolios, competency, and self-regulated learning were analysed and synthesized. This knowledge played an important role in developing an ePortfolio model for self-regulated learning. From this model, an ePortfolio system was implemented that can handle the issues of fostering self-regulated learning, for example, self-regulated learning principles representation and sharing, or self-regulated learning process implementation. The model and implemented system help us to handle the main issues of fostering self-regulated learning (Winne, 2005; Zimmerman and Tsikalas, 2005). The results of this study suggest that the combination of self-regulated learning, ePortfolios, and competency promotes self-regulated learning. This combination leads to a unified platform, in which students can practice all self-regulated learning activities. In addition, these activities are logged for the assessment or modeling of self-regulated learning.

The MSLQ scores show that there were significant differences between pre-test and post-test scores, and between control and experimental groups. It is reasonable to infer the positive effects of the ePortfolio-based learning model on student-motivated strategies for learning scales. Consequently, the impact of the ePortfolio system on student self-regulated learning was recognized based on the framework for self-regulated learning assessment employed (Pintrich, 20014). In addition, the trace data shows that the students implemented and linked the self-regulated learning processes successfully in the ePortfolio environment. This is a key to developing self-regulated learners (Zimmerman and Tsikalas, 2005). The trace data also indicates that student self-regulated learning skills were improved over time by using the ePortfolio-based learning model.

There were some limitations in this research. The MSLQ surveys were conducted at the beginning and at the end of the semester. Thus, the changes of students’ SRL may be due to the passage of time. The lack of time, courses, and students for experiment were other limitations of this study.

For future work, there is a need to conduct more experiments with students from different disciplines and contexts. It is necessary to design and implement evaluation with academic programs. Other types of analysis need to be used to explore ways in which the system affects students’ learning and what needs to change in order to improve the impact of the system on students’ learning, for example, individual level analyses, and artifact content based analyses.
Acknowledgements

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References


Application of GIS: A New Tool to Explore the Administration and Life of the Local Officers of Tang-Song Dynasty

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Abstract: We propose to understand the general status of civilian society dated back to the Tang-Sung Dynasty on the basis of the interaction between officers and civilians through detailed exploration of local administrative affairs of Tang-Song Dynasty. Since history records the activity of people, we also attempt to study the life styles of the literati and officialdom of Tang-Song Dynasty. The true and fake images of the so called “civilian’s parents”, judging from the task, practice and social life of local officers are depicted in order to understand more about the relationship between intellectuals and normal people. Thus describes the vivid and vigorous history of the Tang-Song Dynasty. Geographic Information System (GIS) technology will be applied in this study. The life span and career of local officers of the Tang-Song Dynasty are used as main source of information. It will be processed and integrated through high-tech skill and research and provide the viewers with a new vision of analytical method in historic document. In order to analysis the life of local officers, the bulk of historical sources, such as epitaph, judgment, biography and CBDB, will be served as the historical GIS databases. The GIS database will contain the spatial data including modern and ancient maps, satellite images, natural environments, and artificial scenery, special event, communications network, natural disasters, difference between town and country and conflicting events between populace groups that took place during the Tang-Song Dynasty.

Key words: Tang-Song Dynasty, local officers, court verdicts, epitaph, criminal prosecution, census record

1. Introduction

This research is based on the historical sources of commemorative shrines and steles and then to further examine the dynamic states of inspecting achievement system, understanding the possibility of communication between the central and the local. The main points are two: first, to analyze and discuss the process of how the central power legislated the communication medium between the central and the local. In other words, to look at the relationship between official authorities and local powers from the view of issuing, applying for, and observing the verified cases of commemorative shrines and steles-erecting. Second, by understanding how central power controlled individual official and how to establish models as good local officials, we can discuss the practices of Tang laws.

In addition, the records of commemorative shrine and stele in the Song Dynasty (960-1278) indicate the mutual influence between administration law and practice of Confucianism. According to Confucian officials’ legal principle in the Song Dynasty, the regulations of commemorative shrine must be subordinate to the law of commemorative stele. Though building shrine for virtuous government gradually lost its joint function with inspecting achievements system as it did in the Tang Dynasty, the vocabulary used in the records reflected how government officials held responsibility and self-disciplined attitude in
the Song Dynasty, and the process of building stele demonstrated local official’s principle when enforcing the law and their strategy to adhering to the law.

2. Research Methods and Procedures

Mapinfo 11.5 was used as the software in this study. This article starts with the law in the Administrative Regulations in Book 11 of Tang Legal Code (section on professional regulations) and the Song epitaphs monument pass, a comprehensive review of the local officials of the executive and life in the Song Dynasty. By systemizing those cases of erections of commemorative shrines and steles in the Tang-Song Dynasty and analyzing the time, space, the official positions, and legitimacy of approaches, we can reconstruct the practice of “inspecting achievements” system in the Tang–Song Dynasty.

After the start of the execution plan, first read the fine historical and extant laws Tang and Song unearthed documents, the tomb biography novels, especially dealing with cases where the nature and significance analysis of the career structure Act. From a variety of case classes, compared to normative decrees, in-depth understanding of the principles of a final attempt to analyze the local government office of the trial, the verdict and the Words, observe traditional Chinese official, officials, civil and other duties, changes in living areas.

3. Results

From the 114 cases of Tang Dynasty and 384 cases of Song Dynasty studies of commemorative shrines and steles approved by local officials show that the amount of shrine-erecting cases makes not much difference in the former and latter periods of the Tang Dynasty. Looking at the amount of shrine-erecting cases during each emperor’s reign, we can see that the number of shrines for virtuous government increased after Emperor Gaozong and reached its peak during the reign of Emperor Xuanzong and Dezong. To look at the location for shrines, most of the shrine-erecting events took place in the north, centering around the Chang’an, Luoyang, and the most prosperous zones of downstream Huanghe River and Huai River; Wei Zhou is a special case. In the south part, most of the shrines were found in Xiang Yang and Yanzhou, which both were important cities at that time; the special case in the south is Guangzhou. For the official positions, Provincial Governor, Prefect, and Prefectural Magistrate were most easily to be elected to have a commemorative shrine, and then the County Magistrate. In the Late Tang Dynasty, a lot of shrines for virtuous government were erected by Jiedushi (regional military governor). For the approaches of erecting a shrine, more than 60 percent of the cases were legal, which shows the execution procedure and legal efficacy of shrines-erecting. But on the other hand, in the Late Tang Dynasty, the local officials, citizens, and monks of Buddhism and Taoism from border regions usually went to the central government in groups and requested commemorative shrines for the Jiedushi. This can be taken as an evidence of the rising local power and the increasing difficulty in practicing “inspecting achievement” system.

In fact, the central power of the Tang Dynasty reached deep into the localities by making the local officials to “declare the law” and “appreciate the law”. By using “inspecting achievement” system, such as “reporting is the first policy” and “the achievement is the most important”, the central power created models for officials. And by examining the cases of erecting commemorative shrines and steles, the central power was able to know the government of local officials. The government of local officials was reported from the local to the central, and finally being inscribed on the stone steles.

References


Practical Use of 3D Images in the Interactive Slideshow to Study Traditional Buildings

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Abstract: This study developed the educational materials incorporating 3D images viewable with general application software. The material was the interactive PowerPoint slideshow to allow college students to study Japanese traditional buildings and their conservation independently. In the slideshow, students could explore different areas and watch 3D or 2D images with maps and text. Their impressions and watching behavior were documented to evaluate the impact of the slide show. The results indicated the increased availability of 3D images in the slideshow and the improved exploratory behavior of students to 3D images.

Keywords: 3D images, educational materials, interactive slideshow

1. Introduction

With the advances in digital image technology, the availability of stereoscopic 3D images has expanded not only for professional but also for personal use (Michel, 2013). Therefore, 3D images have become an appropriate and accessible medium for education. However, the ease of use of 3D images in education is limited because of the special computer environment required for its presentation. In this study, we propose a simpler way to incorporate 3D images into teaching material using general-purpose software along with 2D images.

Visual presentation of educational material plays roles in enhancing learning, improving comprehension of the content and attracting the learners’ interest. 3D teaching materials have also been shown to perform these functions (Carrier, Saira, Rosen et al., 2012; Price & Lee, 2010).

2. Methodology

2.1 Learning objectives

We created Microsoft PowerPoint slides for students to help them learn about Japanese traditional buildings and their conservation. The topic was “Important Preservation Districts for Groups of Traditional Buildings” in Kurayoshi, Japan. This ancient district is preserved since approximately 300 years. The slides in this study are intended for students to explore the visuals in the slideshow and study the traditional buildings voluntarily. Thus, the slideshow is interactive and allows students to move from a slide to any other slide.

2.2 Equipment and Stimulus

The slideshow was displayed on a 27-inch passive 3D monitor (LG Electronics FLATRON D2743P-BN). In this monitor, the horizontal stripes of the film-type filter alternate polarization with each line of resolution and 3D images can be viewed through circularly polarized glasses.

All the images in this slideshow were taken by digital 3D camera (Fujifilm FinePix REAL W3). The each 3D image was adjusted adequately and saved in a row-interlaced format adapted for passive 3D monitors using stereo photo editing software StereoPhoto Maker (SPM). The 2D images were made from the left side of the 3D images. The quality of their images was pre-tested.
2.3 Slides

The materials comprise 43 slides (Figure 1). The first slide explains the general characteristics of the district to learn and the navigation method of the slide show. The second slide shows the whole map of this district divided between east and west; students can move between each location by clicking on the images.

Figure 1. Structure and navigation flow of the slide-show

Figure 2. An example of a slide show showing a map, an image, and a description of an object
In the subsequent slides a detailed map containing photo icons appears on the left side. By using PowerPoint’s hyperlink function, students can see a slide of an object when they click a photo icon on the map. The maps contain total 10 icons.

On the right side, an image of an object (i.e., a building or street) and its description appear (Figure 2). The image is viewed in 3D or 2D and students can choose the dimension. Their resolution is 800 × 600 pixels. When students click on the image, it maximizes to full screen size (1920 × 1080).

3. Evaluation of the slide-show

3.1 Procedure

In order to evaluate the impact of the slideshow in this study, students’ impressions and watching behaviors were documented. The participants were 24 college students. Pairs of participants watched the slideshow together without any constraints on slide order or number of viewings. The participants’ behaviors were recorded by macro recorder software. After watching the slide show, the participants rated their impression on a 7-point Likert scale.

3.2 Results

The impressions of the slideshow are shown in Figure 3. The ease of viewing images and the operability of the slideshow were determined to be good. The rated attention to 3D images was stronger than that to 2D images.

It was found that the average number of the images watched in full screen was 4.8 in 3D and 1.8 in 2D and that their average viewing time (sec) was 5.1 in 3D and 4.0 in 2D. Thus, exploratory behavior in watching was greater in 3D than 2D. It is likely that participants were more interested in 3D images than 2D.

![Figure 3. Results of the evaluation of the slide-show](image)

4. Discussion

These evaluation results show that slides combining 3D and 2D images and text in a single display are easy to understand and operate, indicating the increased availability of 3D images used in general presentation software for educational materials. The results also suggest that motivation for learning may be improved by incorporating 3D images into digital teaching materials.

References


StereoPhoto Maker http://stereo.jpn.org/eng/stphmkr/help/index.htm

The Development of Scenario Game Teaching Material for the Learning of Power Networks at Technology Education in Junior High School

Hiroyuki MURAMATSU, Ryoichi KITAZAKI, Hiroyoshi NISHIZAWA, Kiyoshi TANAKA, Saeed RAMEZANJAMAAT, and Phillip L. CARDON

Abstract: The purpose of this study is to develop the scenario game teaching material for the learning of power networks for the junior high school students. Based on the GBS theory, we developed this teaching material that the games main character is in partnership with the power company to supply power stability in charge area. The result of practices will target the first year students at junior high school, we have been able to verify that this material can be utilized as a teaching tool of power network and attract the interests of students.

Keywords: Scenario game, learning of power networks, GBS theory, junior high school

1. Introduction

The modern society cannot survive without electricity. Learning the power network to support the stable supply of power is an important issue of technology education. In junior high school, subject to learn about the power network and energy technology is in the technology category of the technology and home economics curriculum. Also, this content has been shown in the Course of Study of the technology education (MEXT, 2008). We have already been teaching the materials for the power generating technology and the power consumption, but teaching materials for learning the power network is insufficient. In addition, since there is only a limited time in class, it is difficult also to learn experientially about the power network. So, we thought about the use of scenario game materials in studying simulated real problems. The objective of this study is to develop a scenario game teaching materials for the learning of power networks for the junior high school students.

2. Approach

2.1 Basic design of teaching materials

We were using the GBS theory (Goal-Based Scenario Theory) for the design of scenario game teaching materials. The GBS theory is instructional design theory to design scenario type materials that have been proposed by R.C.SCHANK (1996). In this theory, educators can provide a learning environment in a more realistic context by using the concept of "learn by that failure".

The point of the power network technology is to balance the supply and demand of electricity. Trade-off between environmental load and power generation efficiency and power generation technology may also occur there. Therefore, the students will stabilize the power supply in charge of district employees of the power company. " Table 1 shows each element of GBS. In the materials, the objective of this study is to understand the importance of balancing the supply and demand to operate..."
the power company. We also need to have knowledge of power network and power generation technology.

Table 1: Response to GBS theory of teaching materials

<table>
<thead>
<tr>
<th>Material elements</th>
<th>Power generation, transmission, distribution and consumption of low cost, high efficiency and stability.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario context</td>
<td>Mission</td>
</tr>
<tr>
<td></td>
<td>To supply power generation, transmission, distribution and consumption of low cost, high efficiency and stability.</td>
</tr>
<tr>
<td></td>
<td>Cover story</td>
</tr>
<tr>
<td></td>
<td>The games main character is in partnership with the power company.</td>
</tr>
<tr>
<td></td>
<td>Role</td>
</tr>
<tr>
<td></td>
<td>Judgment by engineer of the power company.</td>
</tr>
<tr>
<td>Goal of learning</td>
<td>Understand the knowledge of power network and power generation technology.</td>
</tr>
<tr>
<td>Scenario operation</td>
<td>The power company corresponding to the events that occur in complex.</td>
</tr>
<tr>
<td>Scenario</td>
<td>Feedback</td>
</tr>
<tr>
<td></td>
<td>Stability to the expected cost, efficiency is indicated by the parameter.</td>
</tr>
<tr>
<td></td>
<td>Source of information</td>
</tr>
<tr>
<td></td>
<td>Show the knowledge of power network and power generation technology.</td>
</tr>
</tbody>
</table>

2.2 Development of teaching materials

In order to respond to the restriction of the hardware in home and schools, we have developed a teaching material using the TACS for Flash (Takaaki, 2014, Kojima.et al, 2011). For the materials of their choice, we have set the 3 parameters; stability, environmental load, and cost. It was displayed in 5 step parameter (Fig. 1). The numerical values of the 3 parameters were set based on the cost of power generation and CO₂ emissions of each power generation methods. It is described in the technical arts textbook at junior high school and amount of power generated by the Chubu Electric Power Co.inc in 2013. Also, we have set the event that the demand for power changes for students to allow judgment and selection. (Fig. 2)

For final stage of learning, results are evaluated based on the three-point stability, environmental load, and cost. Then after the awards, students will present a summary of their experience.

![Figure 1. State of the parameters.](image1)

![Figure 2. The demand for power changes.](image2)

3. Verification of teaching materials

We carried out the teaching materials for 42 first year students at junior high school T (2 class) in prefecture N in December 2013. It was performed in the class of the technical arts and home economics curriculum, class time was 50 minutes. Students do not have the learning of energy in the classroom of the technical arts. The classes used a worksheet with scenario-type game teaching materials. Students
used individual desktop PC (OS Windows Vista). We have verified the teaching materials, a) Awareness survey of pre-trial and post-trial questionnaire, b) Evaluation of the teaching materials by post-trial questionnaire.

a) Awareness survey of pre-trial and post-trial questionnaire

We have set 13 question items (Table 2) for the knowledge of transmission and distribution results are 3.33 averages, SD1.03. And for the advanced, the result was more of a post significantly higher at the 5% level (3.64 averages, SD0.93)

b) Evaluation of the teaching materials by post-trial questionnaire

For the evaluation of teaching materials, we have set 13 items. For the answers, we categorize to negative answers for checking 1-3 and to positive answer for checking4-5. For the results of binomial test, it is significantly higher by 5% in 11 items.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q01</td>
<td>I think the work of the power company looks interesting.</td>
</tr>
<tr>
<td>Q02</td>
<td>I am interested in the TV programs or the newspaper about power generation.</td>
</tr>
<tr>
<td>Q03</td>
<td>I want to know about the various power generation methods.</td>
</tr>
<tr>
<td>Q04</td>
<td>I want to know the mechanism of transmission.</td>
</tr>
<tr>
<td>Q05</td>
<td>I think that we should have knowledge of the power generating technology.</td>
</tr>
<tr>
<td>Q06</td>
<td>I think that we should have knowledge of the power transmission technology.</td>
</tr>
<tr>
<td>Q07</td>
<td>I think that we should have knowledge of production and design for energy saving.</td>
</tr>
<tr>
<td>Q08</td>
<td>I think that we should have knowledge about the devising of energy saving equipment to be used.</td>
</tr>
<tr>
<td>Q09</td>
<td>I think to be aware of the energy saving when I use electrical products and machines.</td>
</tr>
<tr>
<td>Q10</td>
<td>I think to try to devise related to energy saving when I make electrical products.</td>
</tr>
<tr>
<td>Q11</td>
<td>I think to try to devise increase the effect of energy saving when I use electrical products and machines.</td>
</tr>
<tr>
<td>Q12</td>
<td>I think to try to use the function of energy saving in electrical products and machines.</td>
</tr>
<tr>
<td>Q13</td>
<td>I think to be aware of the energy saving when I make electrical products.</td>
</tr>
</tbody>
</table>

4. Conclusion

In this study, we aimed to develop the scenario game teaching materials for the learning of power network using the GBS theory for junior high school students. Teaching materials were developed to attract the interests of students. And it can be utilized as a teaching tool of power network. We plan to use in the classroom more often and further improvements will be made in the future.

References

Isei Kojima, other (2011) Development of Educational Material for Scenario Game to let a Junior High Student be Conscious of the Consultation to a Guardian about Mr Trouble, Japan Journal of Educational Technology 35(Suppl.), 169-172 (in Japanese)


The Flipped Classroom: Factors of Self-regulated Learning Affecting Students’ Learning Effects

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Abstract: This study investigates how students’ self-regulated learning affect their learning satisfaction and performance within flipped classroom courses. Eighty-eight undergraduate computer science students taking a flipped classroom course from a private university in the Central Taiwan participated in the study. A Web–based questionnaire was used to collect data on students’ demographics, self-regulated learning as well as learning satisfaction and performance. According to the examination of Pearson’s correlation coefficients, findings show that the effects of flipped classroom are positive correlated with self-regulated learning of students. In addition, self-regulated learning between students’ gender is significant difference in this flipped classroom course as well as learning satisfaction and performance. The effects of flipped classroom are also significant difference between retaking students and other students.

Keywords: flipped classroom, self-regulated learning, learning satisfaction, learning performance, learning effects

1. Introduction

Recent advances in technology and in social network concept bring the evolution of instruction model. Massive Open Online Courses (MOOCs) are a recent development in distance education which began to emerge in 2012. The arrival of MOOCs, which allow hundreds of thousands of students to participate simultaneously in a course, and are free and open to any interested participant, constitute a phenomenon that extends pre-existing initiatives to provide free, educational resources online (Hollands & Tirthali, 2014). Although it is an attractive prospect and rewarding for the teachers to see their work under the sunlight and widely broadcasting all over the world, the potential challenges are that it has much higher dropout rates and lower grades than the conventional kind. A MOOC-like online courses study has been done at Columbia University found that nearly twice as many students dropped out than their counterparts who took the same courses in conventional classrooms. The online students also got lower grades and were less likely to ultimately graduate (Jaggars, Edgecombe & Stacey, 2013). A recent study by researchers investigating the impact of MOOCs also found that few of those who sign up for a course complete it (Ho, et al., 2014). Thus, without a specific class time, students enrolled in MOOCs require enormous focus and self-discipline, and above all, a strong desire to watch lectures and review class materials in a timely manner.

If MOOCs are used as a supplement to classroom teaching rather than being viewed a replacement for it, they can increase instructor leverage, student throughput, student mastery, and student engagement (Fox, 2013). The innovative model is called Small Private Open Online Courses (SPOCs) which supports a current trend in education also known as blended learning or flipped classroom. The flipped classroom is an educational model that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom. According to a survey of the literature related to the flipped classroom through June 2012, Bishop and Verleger concluded that despite differences among 24 studies, general reports of student perceptions were relatively consistent. Opinions tended to be positive and students did tend to watch the videos when assigned (Bishop & Verleger, 2013). Another case study focused on the STEM (science, technology, engineering, and mathematics) courses which instructors teach in a flipped classroom also indicated that the impact on student learning is positive (Herreid & Schiller, 2013).
In this study, the instruction model of flipped classroom was deployed on a computer science curriculum, “Operating systems”. This paper focuses on whether students’ self-regulated learning affects their learning satisfaction and performance within flipped classroom after participating in this learning experience. The study population was comprised of students in a private university in the Central Taiwan. The self-regulated learning scale including four factors: self-monitoring and planning (22 items), self-reinforcement and persistence (8 items), self-evaluation and confidence (11 items), and seeking assistance (7 items), is derived from Jen’s research that is more appropriate for Taiwanese students (Jen, 2011). Each item is answered using a four-point scale (strongly agree=4, agree=3, disagree=2, strongly disagree=1). Another 5-point Likert scale used to evaluate the effects of flipped classroom consists of two factors: learning satisfaction (6 items) and learning performance (6 items).

2. Method

2.1 Participants

Students in College of Computing and Informatics must take the course. The participants included 88 students from the following majors: Computer Science and Information Engineering, Computer Science and Communication Engineering, and Computer Science and Information Management. 53% (N = 47) of participants were male, and 47% (N = 41) were female. 28% (N = 25) of participants retake the course, and 72% (N = 63) take the course first time. This combination provides a good mix of students to investigate the correlation between different objects and learning effects, in particular to students who retake the course experienced both traditional instruction and flipped classroom.

2.2 Research Methodology

In order to exert the characteristics of flipped classroom, we employed a MOOCs platform as a learning management system. The video lectures and exercises prepared by the instructor were used as out-of-class activities. In the class, small group activities were adopted to complete the discussion of homework assignments and oral presentation. After 10 weeks of the course, a Web-based questionnaire was used to collect data on students’ demographics, self-regulated learning as well as learning satisfaction and performance.

2.3 Research Questions

Here are some interested questions that will be examined in this study:

Q1: Is there any correlation between self-regulated learning and flipped classroom effects?
Q2: Is there significant difference on self-regulated learning and flipped classroom effects between different genders?
Q3: Is there significant different on self-regulated learning and flipped classroom effects between retaking students and other students?

3. Results and Discussion

Table 1. Intercorrelations of the Factors of self-regulated learning and flipped classroom effects

<table>
<thead>
<tr>
<th></th>
<th>Self-regulated learning</th>
<th>Flipped classroom effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>self-monitoring and planning</td>
<td>self-reinforcement and persistence</td>
</tr>
<tr>
<td>Learning satisfaction</td>
<td>.238*</td>
<td>.395**</td>
</tr>
<tr>
<td>Learning performance</td>
<td>.312**</td>
<td>.448**</td>
</tr>
</tbody>
</table>

* p < .05; ** p < .01

Q1: as Table 1 shows, the effects of flipped classroom indeed correlated with self-regulated learning, and the correlation is significant. The factor, self-evaluation and confidence, has positive correlation but
is not significant indicated that Taiwanese students usually diffident and lack of self-confidence (the result is consistent with Jen’s research (Jen, 2011)). The reason may be correlated with the quality of home education in Taiwan.

Table 2. Independent samples t-test of different genders

<table>
<thead>
<tr>
<th>Gender</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-regulated learning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>149.74</td>
<td>14.73</td>
<td>3.783</td>
<td>.000**</td>
</tr>
<tr>
<td>Female</td>
<td>41</td>
<td>138.39</td>
<td>13.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flipped classroom effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47</td>
<td>45.38</td>
<td>6.71</td>
<td>2.584</td>
<td>.011*</td>
</tr>
<tr>
<td>Female</td>
<td>41</td>
<td>41.61</td>
<td>6.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q2: as shown in Table 2, after examination of independent samples t-test, there was a significant difference between male and female students on self-regulated learning ($p = .000 < .05$) as well as effects of flipped classroom ($p = .011 < .05$). The result contradicts Jen’s research (Jen, 2011), and the reason may be the course we used in this study was computer science oriented. According to the research results published by Saad et al., there was a significant difference between male and female students who studied science, and female students rated markedly higher than that of male students (Saad, Tek & Baharom, 2009). However, the result in our study is opposite. Therefore, flipped classroom model may play a critical role to enhance students’ learning motivation, in particular to male students.

Table 3. Independent samples t-test of retaking students

<table>
<thead>
<tr>
<th>Retaking Course</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Self-regulated learning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>147.40</td>
<td>12.94</td>
<td>1.156</td>
<td>.251</td>
</tr>
<tr>
<td>No</td>
<td>63</td>
<td>143.29</td>
<td>15.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flipped classroom effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>46.24</td>
<td>6.96</td>
<td>2.241</td>
<td>.028*</td>
</tr>
<tr>
<td>No</td>
<td>63</td>
<td>42.59</td>
<td>6.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Q3: retaking students who experienced both traditional instruction and flipped classroom models could be a typical pointer in this study. The results, as shown in Table 3, indicated that there was a significant difference on effects of flipped classroom. When the dataset was analyzed by retaking students and other students within factors of flipped classroom effects (i.e., learning satisfaction and learning performance), the significance appeared in learning performance ($t = 2.241, p = .028 < .05$). From this finding, we can draw inferences that the flipped classroom will improve students’ learning performance to some degree.

References


