Message from the editor-in-chief

The Malaysian Online Journal of Educational Technology (MOJET) highlights the current issues in educational technology. MOJET is an international, professional refereed journal in the interdisciplinary fields sponsored by Faculty of Education, University of Malaya. This journal serves as a platform for presenting and discussing the emerging issues on educational technology for readers who share common interests in understanding the developments of the integration of technology in education. The journal is committed to providing access to quality researches raging from original research, theoretical articles and concept papers in educational technology.

In order to produce high quality journal, extensive effort has been put in selecting valuable researches that contribute to the journal. I would like to take this opportunity to express my appreciation to editorial board, reviewers and researchers for their valuable contributions to make this journal a reality.

Professor Dr. Saedah Siraj
January 2016
Editor in chief

Message from the editor

The Malaysian Online Journal of Educational Technology (MOJET) is aimed at using technology in online teaching and learning through diffusing information from a community of researchers and scholars. The journal is published electronically four times a year.

The journal welcomes the original and qualified researches on all aspects of educational technology. Topics may include, but not limited to: use of multimedia to improve online learning; collaborative learning in online learning environment, innovative online teaching and learning; instructional design theory and application; use of technology in instruction; instructional design theory, evaluation of instructional design, and future development of instructional technology.

As editor of the journal, it is a great pleasure to see the success of this journal publication. On behalf of the editorial team of The Malaysian Online Journal of Educational Technology (MOJET), we would like to thank to all the authors and editors for their contribution to the development of the journal.

Dr. Norlidah Alias & Dr. Onur İŞBULAN
January 2016
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Enhancing Feedback Via Peer Learning In Large Classrooms

Ng Huey Zher[1], Raja Maznah Raja Hussein[2], Rohaida Mohd Saat[3]

ABSTRACT

Feedback has been lauded as a key pedagogical tool in higher education. Unfortunately, the value of feedback falls short when being carried out in large classrooms. In this study, strategies for sustaining feedback in large classroom based on peer learning are explored. All the characteristics identified within the concept of peer learning were assimilated into a teaching course, in order that the strategies could be properly investigated. Therefore, the outcome of the study is to propose peer learning strategies in sustaining feedback for large classrooms.

Keywords: Feedback, large classrooms, technology-integrated learning environment, higher education, peer learning

INTRODUCTION

Feedback is often described as “the most important aspect of the assessment process in raising achievement” (Bloxham & Boyd, 2007). Students in higher education have placed feedback as a vital component in shaping and improving their learning experience (Covic & Jones, 2008; Price, Handle, Millar & O’ Donovan, 2011; Williams & Kane, 2009; Yorke, 2003). Unfortunately, the use of feedback as a pedagogical tool in higher education is still a dilemma. Carless (2007) stated that feedback activity can be a challenge in teaching large classes. Many good answers go unrecognized in a large group as teachers are constrained with heavy workloads. Ultimately this will push the teachers to think giving feedback is both impractical and too time-consuming (Carless, 2007). As a result, it becomes incompatible with the demands of schooling.

Encapsulating peer learning is recommended as the measure to address this bottleneck. Peer learning provides enriching possibilities for feedback. An effective and productive application of feedback via peer learning in a large class will be seen in activities such as peer commenting, and collaborative authorship whereby students produce feedback comments (Nicol, 2010). In other words, peer learning focuses on students simultaneously learning and contributing to other students’ learning (Boud, Cohen, & Sampson 2001). Boud et al. (2001) also explained this is built upon the students’ mutual experiences which act as a leverage for equal contributions amongst the students’ community. In order to create this condition, the course needs to be designed accordingly. It has also been acknowledged that technology is a vital elevator towards the use of peer learning (Boud et al. 2001). Thus, peer learning, another similar element of the dialogue concept is infused in this study.

As indicated, the research focused on the peer learning activity, and in particular on designing suitable peer learning strategies for sustaining feedback for large classrooms. However, the strategies were
implemented once and application for second cycle was not conducted yet – the opportunity was taken to apply results from the first cycle to identify strengths and weaknesses of the applied peer feedback strategies for large classrooms. Hence the research question was: What are the peer learning strategies for sustaining feedback in a large classroom?

The outcome of this article is to propose peer learning strategies for sustaining feedback for large classrooms.

REVIEW OF LITERATURE

Peer Learning

Boud (2001) defined peer learning as the use of teaching and learning strategies whereby students learn with and from each other without the immediate intervention of a teacher. Peers provide bountiful information which individuals could then use to create their own self-assessments and follow up with actions to improve their work (Liu & Carless, 2006). Evidently, peer learning promotes significant learning which involves students teaching and learning from each other (Keppell et al., 2006). Peer learning has been identified as one of the contributing factors towards sustaining feedback. This learning method amplifies a sense of self-control over learning among students such as (a) exposing students not only to alternative perspectives on problems but also to alternative tactics and strategies and (b) developing detachment of judgement which is transferred to the assessment of their own work (Nicol & David, 2006).

A form of peer learning in the feedback process is peer feedback. Hyland and Hyland (2006) defined peer feedback as a formative developmental process which provides the students the opportunity to discuss and discover diverse interpretations of their written texts. Falchikov (2002) had illustrated that peer feedback plays a significant role in learning because it enables students to perform better self-assessment (Liu & Carless, 2006). Peer feedback should be capitalized as students received more feedback from peers and more quickly in comparison to receiving feedback from lecturers (Liu & Carless, 2006). At the same time, peer feedback should be capitalized on when mass Higher Education is experiencing continuous increase of resource constraints and a decreasing capacity among lecturers in providing sufficient feedback (Liu & Carless, 2006) and diversification of the student population and a decrease in individualized tuition (Nicol, 2010).

It is increasingly evident that peer feedback plays a prominent role in sustaining the feedback process. Liu and Carless (2006) proposed engaging students with criteria and embedding peer feedback. In their study, marks were awarded for the quality of peer marking. The implementation of this step would provide the incentive for students to think carefully about the assessment criteria and be “engaged” in the feedback process. Nonetheless, they found that students do attempt to engage with peer feedback because students do recognize the advantages offered by peer feedback for their own learning development (Bloxham & West, 2004).

Other strategies also advocate the mentioned social elements. For example, Carless (2002) proposed the concept of a ‘mini-viva’ which was a shorter and simplified version of the viva voce examination undertaken by doctoral candidates. According to Carless, the idea for a mini-viva was prompted by the purpose of providing an opportunity for timely feedback to enhance learning before a mark was awarded. The mini-viva was designed to provide prompt verbal feedback on the assignment, after its completion but before a mark was awarded. Awarding mark was positioned at the end of the process because it may be proven to be counterproductive for formative purposes. Peer feedback was applied during the mini viva sessions; it was seen as the appropriate method for this situation as it had the ability to clear the students’ doubts on certain assignment related issues.

Besides that, the peer feedback practice has also been paired with other methods such as the use of exemplars, workshops and group discussions. These three platforms allowed the students an opportunity to engage with the assessment criteria and to discuss with tutors why and how these are applied (e.g., Bromberger & Armstrong, 2011; Harrington et al., 2006; Price & O’Donovan, 2006; Rust, Sambell, McDowell, & Sambell, 2006). The mentioned studies came to a conclusion that peer feedback can be effectively utilized via the suggested methods and environment.
ICT Tools and Peer Learning

Previous research findings reveal evidence of elements of social learning theory such as social networking, peer support and peer community, inspire and add value to the learning when technology is applied. Research by Leidner and Jarvenpaa (1995) and Webster and Hackley (cited in Hrastinski, 2009) argue that online learning was best accomplished when learners participate and collaborate. Herrington and Oliver (2000) found that ICT tools support and improve learning by providing endless opportunities for both students and lecturers to communicate, share and engage in collaborative assignments based upon social constructivist learning theory. Woo and Reeves (2007) pointed out that Internet communication tools, such as e-mail, and bulletin boards, allowed learners to exchange information, contribute to discussions, while providing them with opportunities to communicate interactively one to one or in-groups, making possible opportunities for collaboration such as team projects. Woo and Reeves recommended that online interaction be re-conceptualized in terms of meaningful learning based on the social constructivism learning theory. It had also been suggested that significant interactions within a learning community are antecedent to interactive collaboration which is a critical sociocognitive process in online settings necessary to facilitate critical thinking (Akyol, Garrison, & Ozden, 2009; Kehrwald, 2010). Similar views are echoed by Crook (2012) who revealed that these possible interpretations of learning as a social experience are well supported by the communication and networking tools associated with the current generation of digital technologies.

Based on reviewed literature, several suggestions on peer learning and peer feedback have been experimented. Some of the suggestions were integrated with ICT tools. The researcher also took note of items which could be applied in this study. This can be read in the following session.

PEER LEARNING DESIGNED STRATEGIES

In this section are descriptions on the subject and students’ and instructors context. The explanation on both items would help to understand the application of the peer learning strategies. This is then followed by how the peer learning designed strategies were placed and conducted to cultivate and harness of the power of peer learning. Finally, how technology tools are used to support peer learning designed strategies is discussed.

Contextual Background

The subject

The course; Technology in Primary Education was a 3 credit hour subject. It was a compulsory subject for Bachelor of Education students at a public university in the Klang Valley, Malaysia. This course was aimed at introducing students to the concepts of technology and its applications in teaching and learning in primary education. The students were given three assignments. The assignments contributed 60% to their final grade, with 40% contributed by the end of semester test. The weekly course was conducted within a semester of fifteen weeks.

The physical classroom

The venue for this subject was the computer laboratory. Two computer labs were used because the number of computers was not enough to accommodate the large number of students. One computer lab had thirty-five computers. The computer labs were situated next to each other. All the students were gathered in one computer lab for housekeeping, class presentation, and dissemination of weekly topic. The students were separated into two different labs during group work.

The Teaching Approach

The approach of teaching was blended mode. Besides meeting face-to-face during the three hour class, the students participated in the online forum using the Moodle platform. The assignments were also technology-based. Strategies for implementing the blended learning environment and the execution of the technology based assignments were determined according to the social constructivist approach, the theoretical framework for this study.
The students

The students were primary school teacher trainees. The seventy-five students (42 male, 33 female), were enrolled in the Bachelor of Education (Teaching English as a Second Language) course. The students were not familiar with the tools (Googlesites, Etoys, Moodle) introduced during the course. This information was retrieved during the first class whereby the students were asked if they had any experience using the three tools.

The instructors

One lecturer, assisted by four tutors (including the researcher) managed the subject. The lecturer whom had taught the course for several years was the subject matter expert. She contributed to development of the course design. The three tutors (tutor H, tutor M and tutor R) were enrolled in their Masters in Instructional Technology. Tutor H had 3 years’ experience as a tutor for this course while tutor M had helped for a year. On the other hand, tutor R was new to this position.

Implementation of Peer Learning Strategies in Sustaining Feedback

As mentioned earlier, the aspects of the course which received the integration of the peer learning characteristics are the design of assignments; implementation of the assignments; and the use of technology to execute the assignment and facilitate feedback.

Design of the assignments

For this course, the assignments were designed prior to the components of assessment for learning; tasks that encourage the appropriate learning processes; effective feedback; and students’ development of “evaluative expertise” (Joughin, 2004). The nature of the assignments is illustrated in Table 1.

Table 1 Breakdown of the Assignments

<table>
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<th>Assignment 2 (A2)</th>
<th>Assignment 3 (A3)</th>
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<td>Reflection –</td>
<td>ETOYS Kit with Brennan</td>
</tr>
<tr>
<td>ongoing assignment (20%)</td>
<td>On-going assignment (20%)</td>
<td>(20%)</td>
</tr>
<tr>
<td>Individual task</td>
<td>Individual task</td>
<td>Group task</td>
</tr>
<tr>
<td>Supporting ICT tool-Googe Sites</td>
<td>Supporting ICT tool-Googe Sites</td>
<td>Supporting ICT tool-Etoys</td>
</tr>
</tbody>
</table>

Assignment 1: ePortfolio

ePortfolio is interpreted as a learning space for the learners. It is a virtual platform for the learners to develop products including collection of digital artefacts articulating the learners’ learning (both formal and informal), experiences and achievements. Learners utilized the provided ePortfolio tools to develop ePortfolios for the course.

Today, ePortfolios are being integrated quickly into higher education (Ritzhaupt, Singh, Seyferth & Dedrick, 2008; Zubizarreta, 2009). Batson (2002) has suggested that ePortfolios have a greater potential to change higher education at its very core than any other technology application. Based on the reported studies, for online feedback, ePortfolio has clearly shown its potential in supporting support learners to
capture, collate and reflect on feedback (Wei (2002). This is also acknowledged by JISC (2008) which interpret the ePortfolio as a mechanism for assessment, and feedback. Based on these affirmations, ePortfolio was chosen as one of the course assignments.

For this course assignment, students received instructions that detailed the assignment and grading criteria and suggested potential artifacts. Students adopted Google Sites as the container for the ePortfolio. Google Sites was the choice for the ePortfolio platform because it provided support for comments and feedback, and space for reflection. In other words, the written feedback would be held within the ePortfolio which was Google Sites (Refer to Figure 2). These mechanisms in Google Sites allowed the students easier access to the written feedback and comments. This provided students with ample opportunity to apply feedback as a basis for reflection on their level of competency and development.

At the same time, the opportunities for sharing support for the on-going dialog with peers and tutors/lecturer (Refer to Figure 1) from wherever the students may be physically located. On that account, it provides better and sustainable dialogic interaction, a positive fuel to the feedback culture. Moreover, the students were asked to include their peers’ Google Sites in their ePortfolio. This action of the students’ ePortfolio was ‘shared’ among their group to cement the social element, the key to sustaining feedback.

**Assignment 2: Reflection**

Reflection also allows the student to describe “Ahah!” moments that synthesize knowledge and practice (Karsten, 2012). Furthermore, when students are provided with opportunities to examine and reflect upon their beliefs, philosophies and practices in relation to the contextual conditions of their field, they are more likely to see themselves as active change agents and lifelong learners within their professions (Mezirow, as cited in Ryan, 2012). Prior to these beliefs, the students were to write their WEEKLY reflections (Refer to Figure 2) in relation to what they were learning about technology in teaching and learning. They could evaluate their own thinking in relation to what they were learning. In addition, they were also to include the progress of their given assignment in their weekly reflection. Each reflection or entry was evaluated on the written content.
Posting the entries is insufficient for learning. Prensky (2005) mentioned that content itself would not help students learn throughout their lives but engagement would. Feedback and feed-forward were subsequently enlisted for that purpose. In order to contain the feedback culture, the entry was also assessed based on the feedback given on their peers’ reflection. The students were informed that the type of feedback should not be limited to such “Good writing OR great work OR keep it up etc.” Feedback/comments can be questions on the subject mentioned, a disagreement, OR adding extra information to the current reflection. At the same time, the students had to reply to their peers and tutors’ or lecturer’s feedback. This item was also included in the assessment rubric to prevent passive, linear and static feedback. The objective for assessing the feedback (in terms of quantity and quality) was to ensure every student is involved as an active feedback giver and receiver. The feedback element was graded because the students would need this “motivation” to be involved in the feedback culture.
Assignment 3 was a project-based assignment. Project-based learning (PoBL) is applied in higher education because it supports the development of students’ competencies for problem solving, group work, and self-management (Collis, 1997). Assignment 3 was a group assignment aimed at exposing students to other points of view, teamwork skills, communication, leadership skills, planning and time management (Johnston & Miles, 2004). Anderson and Boud (1996) argued that within a group setting, “microclimate of trust which already exists can be established”. The dialog occurring among the peers in a group is not just a conversation or exchange of ideas. It involves relationships in which the students think and reason together (Gravett & Petersen, 2002). This was crucial in sustaining feedback among the groups.

The students received a two-page document for this assignment. The project tool for Assignment 3 was ETOYS (Refer to Figure 3). ETOYS is a media-rich authoring environment and visual programming system. It is an open-source software programme.

Figure 2. An example of student’s weekly reflections list.

Assignment 3: Project-based Assignment ETOYS

The students received a two-page document for this assignment. The project tool for Assignment 3 was ETOYS (Refer to Figure 3). ETOYS is a media-rich authoring environment and visual programming system. It is an open-source software programme.
For this assignment, each group was to design and create an ETOYS-package according to the subject of choice (English, Mathematics, or Science). Next, the ETOYS-package would be developed based on one of the chosen principles from the Brennan learning principles (2002). The main item of the ETOYS-package was the product created from ETOYS. Since the duration of the project was 11 weeks, the group had to decide on what was manageable and reasonable for the ETOYS-made-product.

**Grouping**

Along the line of Zone of Proximal Development, the social learning theory namely the concept of communities of practice was embedded. This is illustrated when the more mature learners undergo an enculturation process through more specific communities of practices which allow them to develop specialized skills in particular fields (Hung, 2002). The students were divided into three main groups because of the large class. Each main group consisted of five smaller five-person teams. This arrangement was applied to Assignment 2 whereby the feedback mechanism on the students’ entries was circulated among the smaller team within each main group. It was assumed that without this system, students would be favoring their own circle of friends. This was to avoid unevenness in giving and receiving feedback. In other words, all the students would not be left behind in the feedback culture. Within these elements, the feedback journey began to form a dynamic structure.

**Supported activities: Peer review**

Furthermore, class activities such as peer review was used to encourage peer feedback. For example, each group was to present the ETOYS made product during class time. Other groups would be asked to provide their feedback on the presentation according to the given criteria. This method is influential in encouraging student engagement and learning. Peer review strategy allows students to look for guidance from others, while achieving an objective idea of the quality of their thinking and their ability to show their own thoughts in order.

**Technology**

Opportunity to make peer learning “work” was ample given the digital platforms applied for the assignments. The digital platforms ranged from the tools used for assignments to tools applied for administering the assignments (Refer to Table 2).
Table 2 Digital Tools Used for the Course

<table>
<thead>
<tr>
<th>Digital tool</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Sites</td>
<td>Assignments; ePortfolio, Reflection</td>
</tr>
<tr>
<td>Moodle</td>
<td>Administering the assignments / course</td>
</tr>
</tbody>
</table>

Learning Management System: Moodle

Moodle (see Figure 4) is the official Learning Management System (LMS) for the university. The strength of learning management systems will be the embedded communication tools provided to foster and enhance peer learning by providing easy access to the opinions of other students (Keppell & Carless, 2006).

![Figure 4. Moodle page for the course.](source)

For this course, Moodle was the virtual classroom. This virtual classroom provided teachers with the convenience to upload the course weekly materials and put-up course-related website links. At the same time, teachers used this space to publish announcements and for debriefing. This platform also allowed the teacher to conduct discussions with the students via the forum function. The students were also required to use the forum to post any questions regarding the course assignments.
Webpage: Google Sites

Figure 5. Google Sites.

This free Web 2.0 application (Figure 5) was chosen for the ePortfolio assignment. The students had the flexibility to manipulate, embed and add file attachments and information from other Google applications such as Google Docs, YouTube, and Picasa to enhance their ePortfolio on their sites. The features from Google Sites such as adding comments and editing contents provided interactivity among the lecturer and students. This reduced the flat role of feedback while encouraging peer learning.

METHODOLOGY

Sampling

The aim of this study was to identify peer learning strategies for sustaining feedback for large classrooms. Hence, the students of the course were the samples for this study. The number of students from the course was seventy-five (75). The choice of purposive sampling was based on the ability of the sample to provide information-rich cases for the intended study (Patton, 1990). The students were end-users for the applied instructions. The first-hand experience would provide significant data in identifying the instructions for sustaining the feedback process. Therefore, this sampling strategy would permit the selection of a target group which was satisfactory for the specific aim of the research.

Questionnaire

The students were issued with the questionnaire during class time and asked to complete them within a week. The questionnaires were handed in two parts: one during the middle of the course (week 5), and the other at the end of the course (week 15). Week 5 questionnaires were distributed to gauge students’ opinion on their experience in peer feedback. It was also to identify any drawbacks of the peer learning strategies which the lecturer hoped to capture and rectify for the second half of the semester. Week 15 questionnaires were designed to capture students’ ideas and experiences on the peer feedback process. The questionnaires allowed the researcher to generate quantifiable data and to identify general trends in light of the themes emerging from the observation.

Interview

DeMarrais (2004) wrote that an interview is a process in which a researcher and participant engage in a conversation focused on questions related to the research study. Interviews provide useful information because they allow participants to describe detailed description of their experiences. In other words, the researcher was able to enter the participant’s mind (Patton, 1990). Semi-structured guided interviews were conducted on the selected ten students using informal, open-ended questions to gain more information about their experience in peer learning. The purpose of the interviews was to uncover their perceptions and impressions from their experience, and to collect their suggestions and recommendations for future use. Ten students were selected for the interview session. The students were selected based on their face-to-face and online participation in peer learning. These students were active during the peer learning process.
FINDINGS

This section illustrates the findings from the data collected from questionnaires and interviews. Across the data, a number of common themes have emerged and these were discussed in the following paragraphs. Quotations were used to illustrate the points made. The findings revealed the outcomes of the implemented peer learning strategies in sustaining feedback.

It was explained earlier that the class of 75 students was divided into three main bundles. These bundles were further broken to smaller groups of five students each. This measure was to foster peer feedback-learning. Formalized peer learning helped students learn effectively (Boud, 2001). Askew and Lodge (2000) also argued that one of the characteristics of sustaining feedback was to involve students in dialogs about learning which raise their awareness of quality performance. In other words, the peer dialog which occurred among the set groups would in-turn promote the feedback process. The overall response to this strategy was very positive.

When the subjects were asked about peer feedback supported via groups, the majority commented that peer feedback provided tremendous assistance in improving their work such as easier comprehension of the issue at hand, the ability to reflect on their learning, and being able to identify their weaknesses. This was because peer learning allows the students to learn by constructing knowledge as they talked together and reached consensus or disagreement. The comments extracted from the questionnaire clearly reflected that peer feedback enhances learning (Falchikov, 2002) as students were actively engaged in articulating evolving understandings of subject matter (Liu & Carless, 2006). Key phrases extracted from the students’ written statements and interviews such as “noticed my weaknesses”, “understand easily”, “reflect on my learning” depicted a functioning feedback process. Below are some examples of the excerpts:

Through the feedback from my peers, I have noticed my weaknesses in entry. (questionnaire G01)

I learnt much by peers because, through peers, I can understand easily. (questionnaire G01)

My peers help me to reflect on my learning by giving their feedbacks (sic) I learn to accept others’ point of view. (questionnaire G01)

As for me, feedback from peers … may improve my learning process well. Peers also are able to detect my weaknesses, thus, will give appropriate advice or feedback so that I may work toward it. (interview Student Flo)

In line with the definition by Gest et al (2001), friends or peers are interpreted as emotional resources, both for having fun and adapting to stress; and cognitive resources for problem-solving and knowledge acquisition

This led to another form of response, where students turned to one another for support and advice on understanding task requirements (Poverjuc et al., 2012). The students saw their peers as friends. In other words, the term “friend” would simply be illustrated as a person who is honest, and works together through difficulties to achieving success together. With just that concept running through the groups, feedback would continue flowing within the groups without losing its significance.

My friends help me a lot. This is because we are never competitive but always always cooperative. They give me honest views, not telling me things I want to hear only. I improved a lot, thanks to their honesty. (questionnaire G01)

… well, it was encouraging to receive feedback from peers. Through this, we learnt to build each other up in … giving and exchanging opinions and experiences. It was good that peers did actually read our works and commented on it so that I could improve better. (interview, Student Hui)

Comments given were pure support. Whenever I have made a mistake in my post they tell me about something wrong (questionnaire G01)

…feedback that my friends have given helped to build the self-confidence in myself. The feedback helps to produce a better work and writing. The feedback also helps me to realize my mistakes and it helped me to improve my work in order to produce a qualified work. (questionnaire G01)
It was also pertinent to include that if the student viewed and worked with peers who appreciate learning by engaging in learning activities, then the student too would engage in learning and might work harder at learning (Burross & Mccaslin, n.d.). Consequently, peers with positive attitudes and behaviors towards learning allowed and subsequently, would teach each other to set goals such as opportunities to learn and achieve.

This peer support mechanism occurred also because they were the closest people they have of each other. Maslow, Frager and Fadiman (1970) viewed the need for love and belongingness as a step toward achievement in his hierarchy of motivation model, which Maslow described in 1954. According to Maslow, the deprivation of more basic needs hindered progress along the path to achievement. In Maslow’s hierarchy of motivation model, love and belongingness issues must be satisfied so that the achievement needs can be addressed. For example, a student deprived of relationship needs would be less able to engage in classroom learning opportunities. The ability to learn was formed on a foundation of comfortable relationships with peers and family, and classroom learning is about learning with and in the presence of others as iterated by Student Lingam, “...Peers are the closest people that I have around me here through their advises (sic) and feedback and I am able to understand more on the course much clearly “ (interview, Student Lingam). Dom echoed, “...Peers feedback is very important for me because they are whom are close to me (sic). So, they can help me if I request any opinion from them. (interview, Student Dom)

These findings further supported the necessity to create groups for peer feedback in order to sustain feedback. As mentioned by Boud (2001) peer learning settings provide a favorable platform for giving and receiving feedback on the learner’s work and a context for comparing oneself to others.

CONCLUSION

Peer learning is set as the environment for the strategies to sustain feedback. The key to sustaining feedback in large classroom is communication. It has come to the realization that to increase the effectiveness of feedback, feedback has to be conceptualized as a dialog (Juwah et al., 2004). The push to iterative feedback is to make students provide feedback among each other. At the same time, the students would assume some ownership in the role of giving feedback. Being trusted in this role allows them to develop the skill of judgment. One also cannot dismiss that students are often better than the teacher in explaining to their peers in their language which is more accessible. This can be accomplished by integrating the element in the assignments by designing them to accommodate peer feedback. In this study, peer feedback was further pushed in a form of group work. Peer feedback needs a vehicle and one has to pave a road without boulders for a smooth experience. The role of digital tools comes into play. To sustain feedback in a large classroom, the students have to be provided with a variety of outlets such as online forum to communicate feedback. If the feedback information is not converted into action soon after it is created, however, it is a missed opportunity. In other words, the design of the strategies in sustaining feedback in large classroom should capitalize the element of social constructivism. Individual based strategies will be unable to express the power of feedback.

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Geogebra As An Artist’s Paintbrush

Muharrem Aktümen [1], Avni Yıldız[2]

ABSTRACT

One of the definitions of mathematics is that it is “a science of patterns and themes”. Within the scope of this definition, the current software technology facilitates the creation of visuals and patterns. Thus, GeoGebra software was used. The study was carried out in two stages. In the first stage, the Dynamic Geometry Software and the Discovery of Mathematical Concepts class was taught. In the last stage, the preservice primary mathematics teachers were given an assignment and asked to continue in groups. The groups were told that they were expected to produce aesthetically pleasing visuals and patterns. Therefore this research aimed at investigating how preservice teachers determine the design process and how they solve problems encountered during the process. Thus, as can be seen in the literature, the method and design as a long term study are the new contributions to the literature. Case study was carried out with 39 second-year preservice mathematics teachers. The research data were collected through preservice teachers’ finalized projects which included a Microsoft -Word document that described in detail the process, screenshots, and GeoGebra applications. The data were analyzed by using the content analysis technique. As a result of this study, preservice mathematics teachers entered into research and analysis activities, investigated to create original designs, spent more time on the significance of visuals and patterns and so many groups made various creative tasks.

Keywords: Mathematics Teaching, GeoGebra, Aesthetics, Design, Pattern.

INTRODUCTION

The common ground of most studies on mathematics education is “how can we teach mathematics better”. However, “teaching only with speaking” is called the traditional approach and is not enough anymore, since this approach ignores the cognitive abilities and self-improvement of every student (Dikovic, 2007). It should not be forgotten that the ideal learning environments are encouraging platforms for students to discover the ideas they produced (Battista, 2001). According to Freudenthal, mathematizing is the core goal of mathematics education (Freudenthal, 1973). In this context, Zbiek and Conner (2006) point out that modelling contributes to understanding mathematical concepts thoroughly by demonstrating the applicability of mathematics to real life, and to learn new mathematical concepts, to establish inter disciplinary relations between the conceptual and operational development of the students.

One of the definitions of mathematics is that it is “a science of patterns and themes” (Toluk, 2003). Within the scope of this definition, current software technology facilitates the creation of visuals and patterns and allows us to carry it one step further. Thus, this new technology not only facilitates the calculation and drawing of graphs, but also changes the nature of the important problems in mathematics and the research methods (Baki, 2002). Sendova and Grekovska (2005) pointed out that building a computer model of a construct is motivated to elaborate one’s knowledge in mathematics and informatics. Accordingly, such operations as translating, shifting, expanding and reducing can be performed by the students themselves, as
part of a dynamic process (Aktumen et al., 2010).

Technological tools enable the discovery of certain new mathematical concepts. This experience of discovery enables formation of powerful geometric intuition and prediction skills, which are essential for problem solving and theory building in any field of mathematics (İsmail and Kasmin, 2007). However, unfortunately, it is determined that teachers frequently use computers for presenting slide shows (Aktumen, Yıldız, Horzum and Ceylan, 2011; Dikovic, 2009; Kabaca, Aktumen, Aksoy and Bulut, 2010) whereas most researchers underline that students enjoy the learning process more actively with computers and use this technology as a tool for exploring (Anabousy, Daher, Baya’a and Abu-Naja, 2014; González and Herbst, 2009; Lachmy and Koichu, 2014; Santos-Trigo and Cristóbal-Escalante, 2008; Van Voorst, 1999). Therefore, in this study, primary preservice mathematics teachers’ design processes were examined using software within an assignment in one lesson duration.

One of the most effective methods recommended by researchers for the conceptual grasping of mathematical concepts by students is the use of multiple representations/displays (Brenner et al., 1997; Porzio, 1994, cited in Özmantar et al., 2008). The relationships among representations is strengthened through transitions from one representation to another when working with multiple representations (Akkoç, 2006). It is not always possible to view the relationships among such representations. To clearly view the relationships among multiple representations necessitates the use of dynamic mathematics software. GeoGebra, the dynamic mathematical software employed in this study uses algebra, drawing board, spreadsheet views, mathematical symbols, graphics and table transfers, as part of a dynamic process, to provide rapid transitions between representations, which sets it apart from other dynamic geometry and algebra software (Aktumen et al., 2010). Moreover, GeoGebra software expands the dynamic geometry concepts, and adds a new dimension to mathematics and algebra (Dikovich, 2009). Besides that, GeoGebra’s interface has been translated into Turkish and it is a free software; it can be extended and is open-source (Aktumen and Kabaca, 2012; Aktumen et al., 2012; Aktumen et al., 2011; Kabaca and Aktumen, 2010). The advanced modeling capabilities offered by GeoGebra has also been instrumental in its selection as the focus of this study.

**Literature Survey**

Literature review shows that articles on GeoGebra software fall under four main headings. The first category is composed of some studies in which a lesson, constructed with GeoGebra, and some variables are examined (Dikovic, 2009; Saha, Ayubb and Tarmizi, 2010; Tatar, Kağızmanlı and Akkaya, 2014). The second is represented by studies in which mathematics teachers and pre-service teachers’ views are examined (Aktumen et al., 2011; Kutluca and Zengin, 2011). The third consists of studies in which some variables are examined in the problem solving processes with GeoGebra (Baki, Yildiz and Baltaci, 2012; Yıldız, Baltacı and Aktumen, 2012). The last is composed of the studies in which a certain geometric locus is discussed with GeoGebra software (Antohe, 2009; Baki, Çekmez and Kösa, 2009). Although mathematical patterns, tessellations and designs allow for appreciation of the relationships between mathematics and other domains, as can be seen in the literature, after a long education term, and after a comprehensive assignment given the preservice teachers, they are not assessed on the designs nor the design procedures.

**Purpose and Importance of the Study**

In the assignment, stated as extracurricular, the aim of this research is formed as: How do preservice teachers determine the design process and how do they solve problems encountered during the design process.

Due to the GeoGebra dynamic mathematics software, the problems related to real life can be modelled for the students as improving the motivation about mathematics (Price and Stacey, 2005). On the other hand, as can be seen in the previous literature survey, the method of this study is one of the new contributions of the study to literature as well as it is a long term study. Thus, according the results of this study show that computers are not only used for providing visuals.
METHODOLOGY

Research Method

In this research, we used the case study method as it enabled us to examine a particular group in depth and to assess the data obtained through data collection tools without being concerned about generalization.

Participants

The study sample consists of 39 second-year primary preservice mathematics teachers from a state university enrolled in primary school mathematics instruction, during their fall semester. The participants were 17 males and 22 females. The average age of the participants is 20 years. Their mathematics proficiency level is good enough and their general attitude to mathematics is positive.

When taking courses on basic ICT skills in their first year at university, primary preservice mathematics teachers began interacting with GeoGebra in two courses. They were guided in these courses by a lecturer, who had organized various in-service training sessions on using GeoGebra in mathematics education. Table 1 presents some information on the content of these courses.

Table 1. The Lessons Where GeoGebra was Used Before the Application

<table>
<thead>
<tr>
<th>Course Details</th>
<th>The Method of Using GeoGebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Mathematics</td>
<td>In this course, GeoGebra is used only for the purpose of presentation by lecturer when needed: For example; drawing the trigonometric functions’ graph by using unit circle, drawing function, the relation between the function and inverse function, the construction of limit concept etc.</td>
</tr>
<tr>
<td>First Year 6 Hours</td>
<td></td>
</tr>
<tr>
<td>Geometry</td>
<td>In this course, GeoGebra is used only for the purpose of presentation by lecturer when needed: To test the theorems belonged to Oklit geometry (menelaus theorem, pisagor theorem, basic rate etc.) in order to make it more understandable, provide an argument environment etc.</td>
</tr>
<tr>
<td>First Year 3 Hours</td>
<td></td>
</tr>
<tr>
<td>Calculus I</td>
<td>In this course, GeoGebra is used only for presentation by lecturer when needed: For example; To examine the derivation of function concepts in table, graph and algebra representation, Riemann integral, the method of rectangle, to draw parametric curve etc. This lesson was instructed at the same term of application.</td>
</tr>
<tr>
<td>Second Year 6 Hours</td>
<td></td>
</tr>
</tbody>
</table>

Procedure

The study was carried out as part of the Dynamic Geometry Software and Discovery of Mathematical Concepts course. It was designed in two stages. In the first stage, the Dynamic Geometry Software and Discovery of Mathematical Concepts course was taught by the researcher for a 9 week period for 2 hours per week. As part of this course, the basic features of GeoGebra were described to the preservice mathematics teachers and they were given the opportunity to develop GeoGebra applications corresponding to algebra and geometry concepts. At the end of this stage, the preservice teachers were given an assignment and asked to continue in groups, and 13 groups of three students each were formed. The groups were told that they were expected to produce aesthetically pleasing visuals and patterns using their knowledge of mathematics, and their GeoGebra skills. The groups were then left alone and no limitations were applied. As proposed by Kalayci (2008), the patterns were determined by the groups themselves and guidance was provided by the authors. The groups were given a four week period for the pattern creation process.
Data Collection Tools

The groups were asked to turn in to the authors, as their finalized projects which included a Microsoft-Word document that described in detail the process used in creating the patterns, screenshots of the pattern samples, and GeoGebra applications containing their patterns. From the Microsoft-Word document, it was decided how the teachers determined designs, what they did, how they overcame the problems, since the preservice teachers were asked to write this duration in detail. It will help us to reflect the process better by writing the opinions of the preservice teachers in the findings part. The research data were collected via these tools.

Data Analysis

The data from the documents were analyzed using the content analysis technique. The content analysis process involves compiling the similar data under certain concepts and themes and to comment on these in a more comprehensive way for readers (Yıldırım and Şimşek, 2005). Additionally, Bali and Ramadan (2007) have stated that opting for the content analysis technique works well for small scale samples or for samples determined using a specific criteria (cited in Yenilmez and Ersoy, 2011). In this context, each student's documents were analyzed in depth and themes were determined. The themes were then specified by the authors and an expert independently from each other and were brought together and put into their final forms. At the end of discussions, the agreed themes were selected to answer the research problem. The reliability of the research was ensured in this way.

Saban (2007) has stated that to increase self-confidence and validity, student opinions may be frequently quoted. Part of the expressions from the documents created by the preservice teachers have been quoted in their original form in this study. When using the quotations, preservice mathematics teachers have been assigned ID numbers from 1 to 39; as an example, the preservice mathematics teacher corresponding to 1 has been shown as Ö1.

FINDINGS

As a result of content analysis on documents created by the groups, seven themes are found to emerge. In the following, the themes established in the design process are exemplified.

Preservice mathematics teachers were able to connect algebraic and geometric representations when inputs were changed

Preservice teachers expressed their thoughts as part of this theme as follows:

Now we have made various changes to the functions and the curves, to come up with different shapes. For example; we added multiplication of cos(x+b) to function f. (Ö1)

We realized that for half of the intervals where c(x) = sin(x)^sin(x) and b(x) = cos(x)^cos(x) have definitions on the x axis, these intervals are common. Later we simultaneously displayed the graphics for b(x) = cos(x)^cos(x) and e(x) = cot(x)^cot(x). We noticed that the e(x) function begins at the start and end points of the b(x) function and continues, and that it is defined for a smaller interval compared to the b(x) function.
As seen from these representations, GeoGebra is able to simultaneously reflect to the graphical window changes made by the preservice mathematics teachers to the algebraic expression, and conversely, reflect to the algebraic expression any changes made in the graphical window; in this manner, it enables the preservice teachers to establish relationships between the algebraic and geometric representations when inputs were changed.

Some preservice mathematics teachers were able to select the proper mathematical concept

The following are some preservice teachers’ expressions assessed as part of this theme:

Following a discussion, we decided that this shape not only resembled a ghost, but also the ear and the eye of a mouse. So we decided to do additional work on it. We tried to make this pattern resemble the head of a mouse. We decided to craft a mouth for the mouse and felt that it could be accomplished with the help of an ellipse. We generated an ellipse and placed it below the eyes of the mouse. We formed a nose with the help of a circle and placed it above the ellipse. Then, with the help of a function, we created two whiskers for the mouse. Finally we graphed teeth for our mouse using lines and line segments.

We had to create a body for the tulip. We had to define a function to flesh out the body. The formula for the first function we tried is: Function \[10x^3, -2, 0\]. The resulting shape was as follows. Seeing this output, we sensed that there was no need to try the mirror image of the body. Now we had to try another function, but what could we try that would give us a flower-like body with the bowl contacting the petals at the correct location and would look like as if it was a part of the tulip? We started to try other functions. After a few trials, we found a body as follows, with the formula: Function \[-(x - 1)^3 2, 0.75, 2.25\]. This was the shape that came out and we really felt like we could use the application.
Later, as the shape that was forming, started resembling a butterfly’s wings, we used the same formula to create additional wings by modifying the axis and wrote it as shown below. (Ö 20)

- To form the butterfly’s antennas:

\[
\begin{align*}
  f(x) &= -5 \sqrt{x} \\
  g(x) &= 5 \sqrt{x} \\
  h(x) &= -5 \sqrt{-(x)} \\
  k(x) &= 5 \sqrt{-(x)}
\end{align*}
\]

After writing out the functions, in order to describe the antenna shape, we entered the functions in the input field as follows...

As shown, during the process for creating an envisioned pattern, it was observed that a portion of the preservice teachers displayed the skills to select the proper mathematical concept among several available.

Some of the preservice teachers’ abilities to predict and generalize were exhibited during the process

Some preservice teachers expressed their thoughts as part of this theme:

This pattern, which resembles an egg, came about as a result of adding an angle, and captured my interest. If one angle could be the source of so much change, the addition of a function into the curve could . . generate better result. So we decided to create the function and add it into the curve. (Ö 25)

I had researched the homework you gave us for the Analysis class. The homework was for finding the derivatives of \( \text{arctanh}(x) \) and \( \text{arccoth}(x) \). So I researched it and showed you the result. When you looked at it, you connected the graph to the sequence using \( \text{arctanh}(x) \) and \( \text{arccoth}(x) \). We were impressed with that figure and so we connected the graph of the derivative of \( \text{arctanh}(x) \) to the sequence. Sequence \([ i \text{ Derivative}[\text{arctanh}(x)], i, -10, 10, 0.5] \). (Ö22) (FIG. 3.)

Fig. 3. Polygon and a water drop

As can be seen above, some preservice teachers predicted and were curious about the results, so they formed the design process in this way. On the other hand, some of the preservice teachers took the essential steps after they generalized the former information, as can be seen in the example above.

The preservice teachers showed the skill of using mathematical content in their designs by using different information sources

Preservice teachers expressed their thoughts as part of this theme in the following excerpts:

First we searched for ‘trigonometric functions’ using Google. (Ö35)

We browsed our notebook to see whether there was a topic we had not thought of. When I reviewed the notebook, I saw that it actually contained exactly what I had been thinking of. I realized I had to learn the
topic of sequences. (Ö 2)

We formed this pattern using an internet search. We wanted to create patterns related to cyber spaces (nested labyrinths), fractals, the Fibonacci series and the golden ratio, but we could not really get a lot done. We again consulted a book on the fundamentals of mathematics; additionally we examined such patterns as spider webs and honeycombs. We also tried some functions we retrieved from basic mathematics books. (Ö 8)

We examined the formula for the ellipse in the section for conics from the mathematical geometry formula booklet published by the X training center. (Ö 19) (FIG. 4.)

Fig. 4. Ellipses

As seen from above, GeoGebra environment has enabled preservice mathematics teachers to try other sources of information. These resources are university text books, the internet, lecture notes and supplementary text books.

Preservice mathematics teachers sought aesthetically pleasing results

Preservice mathematics teachers expressed their thoughts as part of this theme:

At first, we define an “f” function. After that, by using function we define a “g” function. The gap of the “g” function is determined from 1 to 10. The functions are as in the following:

\[ f(x) = 1 - 2\sin(x) \sin(x) \sin(x) \]
\[ g(x) = \text{Function}[x^4, 1, 10] \]

We thought to use it in curve by adding some trigonometric functions.

\[ \text{Curve } [f(a) \cos(a + \alpha), f(a) \tan(a + \alpha), a, 0, 10] \]

In this figure, by bounding a angle to cursor in the gap \(0^\circ, 360^\circ\) we complete the increment 5°. We bounded a to cursor and minimum 0.1, maximum 5, the increment was completed as 0.4. Then, we pushed to Enter. After opening the vitalization and trace the figure was emerged as below (Fig. 5.).

Fig. 5. Outer space
As can be seen above, when we look inside of the figure, the pattern is getting more identical to outer space. But we do not like this pattern. Because we were not satisfied with that. We wanted to find more different patterns... (Ö 2)

After adding some trigonometric functions randomly, we found the formula below. We define b as \((0, \pi)\) and a bounding to cursor in the gap \((0°, 360°)\), with \(0.1°\) increment. And the formula is:

\[
\text{Curve } [g(b + \alpha) \sin(b + \alpha), f(\alpha + b) \tan(b + \alpha) \sin(\alpha + b) \cos(b + \alpha), b, 0, \pi]
\]

After writing this function and pushing enter, and opening the vitalization and trace, we got Fig. 6.

![Fig. 6. Heart](image)

The shape above resembles a heart. We felt very happy when we first saw this pattern. We thought we were done, but then we felt it might not be good enough, so we decided to try new functions. (Ö 11)

Working on this topic was going to be exciting for us, as we were thinking that we would be getting new patterns each time. (Ö 21) (Fig. 7)

![Fig. 7. Designs within a circle](image)
When the documents prepared by the preservice teachers were examined, it was determined that as above in certain cases they did not like the patterns they formed, and in certain cases they did. However, in both cases the process led them to create new patterns.

**Some preservice teachers gain self-esteem with improving to use GeoGebra software**

Some preservice teachers expressed their opinions as part of this theme in the following:

*We set it so that Sequence_1= Sequence[Sequence[(i,j),j,9.9,r,-0.3],i,9.9,r,-0.1]. We set initial values of i and j as 9.9 and we set their increment values as -0.1 and -0.3 such that it would appear to come from the opposite side as the reverse of the first sequence. It starts from 9.9 as we did not want it to overlap with the first sequence. And we created slider r, decreasing from 10 to 1, having slider speed of 0.5 and a decrease rate of 0.01.* (Ö 1)

As it is seen from above it can be stated that a project such as this one advances the skills of some preservice teachers for making use of the GeoGebra syntax. This situation facilitates them to create a good pattern with self-esteem.

On the other hand it was observed that a portion of the preservice mathematics teachers researched and used in generating their patterns features of GeoGebra that were not covered as part of the lectures. The following are preservice teachers’ expressions assessed as part of this theme:

*We decided to issue new commands. We decided to use the circular sector (CircularSector[<Point>, <Point>, <Point>]) found on the help button at the lower right-hand corner of the GeoGebra window.* (Ö 36) (Fig. 8)

![Fig. 8. Color and Pattern](image)

**Most of the preservice teachers assimilated the patterns they created to the real life objects**

Preservice mathematics teachers expressed their ideas as part of this theme in these excerpts:

*The week we learned about the curve command, Bülent had been promised tea and simit (Turkish bagel) by you. I had an idea and shared it with members of my group. We explored how we could end up with the shape of a simit.* (Ö 25) (Fig. 9)

![Fig. 9. Simit (Turkish bagel)](image)
We felt that the generated shape resembled decorations used for New Year’s Day celebrations. The images on the screen of algebra and graph are given in Fig. 10 (Ö29):

When we rotated the curve we obtained this time, we realized that it formed the pattern of a tulip. (Ö4) (Fig. 12)
Although it was stated to the preservice mathematics teachers that project expectations were for them to create visually pleasing shapes, as seen in their submissions a majority of the preservice teachers were striving to convert the shapes they generated into those that resembled real-life objects.

DISCUSSION AND RESULTS

Mathematics teachers and instructors are attempting to develop various strategies to make mathematics interesting and meaningful (Penas & Guzon, 2011). Several studies indicate that classroom work may be made more enjoyable using dynamic geometry software (Furner & Marinas, 2011; Kutluca & Zengin, 2011; Sendova & Grekovska, 2005; Wakwinji, 2011). Therefore, teachers should be attentive and use GeoGebra efficiently in their classrooms (Baltaci & Yildiz, 2015). In addition, for having more fun, some enjoyable activities designed by students using dynamic geometry software will also help them get a sense of appreciation of mathematics as art (Ismail & Kasmin, 2007). As described in the study findings, the preservice mathematics teachers have carried out a study to prepare aesthetically pleasing visuals and patterns which they found to be interesting. Moreover Penas and Guzon (2011) visualized certain learning, teaching and research activities through the use of applicable technological tools and the utilization of tessellations and designs. In the same study, Islamic tessellations were used as part of establishing connections among arts, history, culture and abstract mathematical concepts. Consequently, they emphasized that the various histories and cultures of the world hold immense potential resources for studies to be conducted in mathematics and other domains of knowledge. Thanks to technological advances, such connections are easily established.

In this study preservice mathematics teachers have been able to enter into intensive effort on algebraic and geometric representations and have been able to observe the relationships between these two representations when inputs were changed thanks to the GeoGebra software features. Thus, the preservice teachers were able to see both graphics and algebra at the same time; when they made alteration in one window, they could see the change in the other window at the same time. Contrary to some other software, the diversity of GeoGebra software is one of its important roles as observed in this study. Because GeoGebra is a free and dynamic software that integrates algebra and analysis in a single package (Baki, Yildiz, & Baltaci, 2012; Tatar, Akkaya, & Kāģizmanlı, 2014), educators should benefit from this software for a more efficient learning and teaching process.

Cuoco and Goldenberg (1996), Laborde et al. (2006) and Olive (2002) have concluded that the learning process taking place within an environment incorporating dynamic geometry software is not a process where information is provided and is then simply received, but one where individuals form their own knowledge of geometry or where they re-fashion their existing knowledge. It has been observed that this process has also been experienced by the preservice teachers taking part in this study; some preservice teachers were able to pick up the mathematics concepts from the acquired information for their design, and most of them were able to use the acquired mathematical content in their designs by constructing with their own knowledge and accessing different information sources.

Dikovic (2009) and Lachmy and Koichu (2014) pointed out that various mathematical structures can be
explored using GeoGebra software. This situation supports the judgements like “some preservice teachers gained self-esteem in using GeoGebra by improving their abilities and the preservice teachers tried aesthetical designs”. Most of the preservice teachers gained enough motivation with this kind of application and conditioned themselves to create the best design. These teachers made an effort to use GeoGebra software in parallel with their imagination. In the related literature, it is stated that the students were more eager and did not get bored (Chrysanthou, 2008) and became more motivated by using this kind of software (Bakar, Ayub, Luan, & Tarmizi, 2010; Tezer & Kanbul, 2009).

Arcavi and Hadas (2000), González and Herbst (2009) and Ismail and Kasmin (2007) have stated that in addition to visualization, dynamic geometry software contributes to student learning through experience, and as a result, students perform not only observations but also activities such as measurements, comparisons and modifications to figures. As stated by the preceding studies, preservice mathematics teachers have performed in a dynamic environment such activities as performing measurements, comparisons, and modifying figures. According to Karataş and Güven (2008), computer assisted environments allow students to make assumptions, test such assumptions and make generalizations. Making assumptions and testing them were frequently observed in the applications created by the preservice mathematics teachers in this study. Our results suggest that preservice mathematics teachers facing such creative tasks where constructivist applications are found will have motivation for classwork, will seek to create original designs, will enter into research and analysis activities and will spend more time on the significance of concepts.

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Modeling Learner Situation Awareness in Collaborative Mobile Web 2.0 Learning

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ABSTRACT
The concept of situation awareness is essential in enhancing collaborative learning. Learners require information from different awareness aspects to deduce a learning situation for decision-making. Designing learning environments that assist learners to understand situation awareness via monitoring actions and reaction of other learners has been reported to be beneficial in enhancing collaborative learning. An emerging learning mode is mobile Web 2.0 learning where Web 2.0 tools support mobile learning – allowing for personalization, ubiquity and social connectivity in learning. Thus, the study investigates and models learner situation awareness in collaborative mobile Web 2.0 learning. Participants were novice teacher trainees in a local university. The study was conducted over a four-month period. Data were collected via questionnaires and analyzed by PLS-SEM analysis. The results revealed that learner situation awareness in collaborative mobile Web 2.0 learning is reflected by six factors: learning reflection, learning space, learning community, social, task, and personal awareness. Results also showed that learners perceived learning reflection awareness as the most important factor.

Keywords: Learner situation awareness, collaborative mobile Web 2.0 learning, learning reflection awareness, novice teacher trainees, higher education

INTRODUCTION
An interesting mode of learning utilizing the advancement of global mobile and sensor technology is the mobile learning mode. The ubiquity and the connectivity of wireless mobile devices as well as mobile Web 2.0 technology allows for disruption of traditional teaching and learning practices – serving as catalysts for pedagogical change from an instructor-delivered content toward student-generated content via peer collaboration (Ally, 2009; Cochrane, 2014; Kukulska-Hulme, 2010). Mobile Web 2.0 enables mediation of student-generated learning context and content, which underpins a basis for students to work in collaborative teams to encourage critical thinking with appropriate scaffolding by instructors (Cochrane, 2014). This shows a huge potential in implementing these technologies in the current global and local education sector (Ally and Samaka, 2013; Din et al., 2012; Nordin et al., 2010; Siraj and Norman, 2012). Recent research has demonstrated that mobile Web 2.0 has the potential for supporting student collaboration in social networks besides facilitating student-generated content (Cochrane, 2014). Mobile Web 2.0 utilizes mobile-optimized Web 2.0 tools as a platform for engaging students and instructors in learning conversations within authentic learning environments. It also has the potential to integrate personalized learning as well as ubiquitous social connectedness in a pedagogical design learning context (Cochrane, 2014; Cochrane and Bateman, 2010).

Because mobile Web 2.0 learning is different from the traditional mode of learning, it requires different teaching and learning approaches to utilize or enhance its potential (Cochrane, 2014; Keskin and Metcalf, 2011). Although many studies have approached mobile learning from the computer-supported collaborative
learning (CSCL) and computer-supported collaborative work (CSCW) point-of-view, yet few studies model/frame/investigate mobile Web 2.0 learning from the perspective of situation awareness (Cochrane, 2014; Phielex et al., 2011). Situation awareness is defined as “the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future” (Endsley, 2000). In cognitive science, situation awareness is defined as “in-between state” of the decision-making process as one “makes-sense” or deduces a situation in order to make an appropriate decision (Artman and Garbis, 1998; Belkadi et al., 2012).

The concept of situation awareness is usually investigated in complex environments such as aviation, cyber security, intelligent systems, complex operational environments, and medicine (Bolstad et al., 2010; Dutt et al., 2013; Miller and Trappe, 2010; Melander and Sahlinstrom, 2009). For example, in aviation, Melander and Sahlinstrom (2009) investigated pilots’ capability to correctly perceive and interpret a situation with situation awareness. Although situation awareness is usually investigated in complex environments, learning environments can also be considered as complex environments (Van Merrienboer & Kirschner, 2012). Studies that apply situation awareness in learning environments include the works of Jacobsen et al. (2011) and Spector et al. (2013) where the former investigated scaffolding of learning in complex systems, while the latter studied knowledge construction in complex domains. However, although there is a significant amount of work on situation awareness in learning, there is a noticeable gap in studies of situation awareness in mobile learning, especially in mobile Web 2.0 learning. Thus, in this study, we investigate learner situation awareness in collaborative mobile Web 2.0 learning settings. As such, we developed a mobile Web 2.0 learning environment called Mobi2Learn (Mobile Web 2.0 Learning) to assess learner situation awareness in collaborative mobile Web 2.0 learning settings.

**Review of Literature**

This study originates from the context model of Kofod-Petersen and Cassens (2006). Belkadi et al. (2012) suggested the terms “situation” and “context” can be used interchangeably because “context” or “contextual information” is usually closely associated with supporting “situation” awareness. In relation to context, De Araujo et al. (2004) defined “context” as information that is used to characterize the task of the group—in which the information offers conditions for team members to become aware and understand all the factors influencing their interaction before making a decision on how to interact. This can be linked to Schmidt’s (2002) definition of “situation”, where the author defines “situation” as a meaningful space where cooperating workers act and interact among themselves. As there is a link between the concepts of “situation” and “context”, we have attempted to model learner situation awareness in collaborative mobile Web 2.0 learning using the “context” model of Kofod-Petersen and Cassens (2006).

Before moving in depth on Kofod-Petersen and Cassens’s (2006) model, we review the frameworks and models related to “collaborative mobile learning”. Integration of technology in collaborative settings usually involves implementing the approaches of computer-supported collaborative learning (CSCL) and computer-supported collaborative work (CSCW) (Belkadi et al., 2012; Janssens and Bodemer, 2013). Past CSCL models include works by Stahl (2004) and Janssens and Bodemer (2013), where the former emphasized group cognition while the latter stressed the importance of distinguishing between cognitive and social awareness.

The emergence of mobile technology has further expanded collaborative learning opportunities. Although previous researchers have classified mobile learning as an extension or “sub-set” of e-learning (or CSCL), however, recently, educators have defined mobile learning as a separate mode of learning as compared to e-learning or CSCL (Traxler, 2009). The more recent definition of mobile learning is learning that is defined by the “mobility” state of learners in which they can access their personalized learning environment as they physically move (Kukulska-Hulme, 2010; Sharples et al., 2010; Traxler, 2009). Since there seems to be a distinction between mobile learning and e-learning (CSCL), there is a need for developing frameworks and models that address mobile learning under collaborative settings termed “collaborative mobile learning” (Ryu and Parsons, 2012).

Recent works in collaborative mobile learning include works of Buchem et al. (2012) and Ryu and Parsons (2012). Buchem et al. (2012) studied the integration of collaborative mobile learning into the university’s curriculum via participatory curriculum development. The study included students as curriculum
developers and identified several potential implications and challenges to implement such mode of learning. Ryu and Parsons (2012) investigated the social flow in collaborative mobile learning. They discovered that collaborative mobile learning has the potential to enhance learning via dynamic interaction among group learners.

However, there seems to be a gap in previous studies regarding collaborative mobile learning (CML). First, although a number of studies address learner situation awareness in CSCL and CSCW, only limited studies have examined CML in relation to learner situation awareness. Second, there is an inadequacy in terms of developing frameworks that address learner situation awareness, which are analyzed and verified with quantitative modelling techniques such as structural equation modelling (SEM). In order to address these issues, the context model of Kofod-Petersen and Cassens (2006) was selected in modelling learner situation awareness for collaborative mobile Web 2.0 learning. The model could be of value for understanding the aspects involved during collaborative mobile Web 2.0 learning settings. The model is based on “activity theory”, used by many in the mobile learning community to describe human activity.

Research Model and Hypotheses

The context model of Kofod-Petersen and Cassens (2006) as the basis of analysis

This study is part of a larger study on modelling learner situation awareness in collaborative mobile Web 2.0 learning. The larger study involved two parts: (i) development of the learner situation awareness model for collaborative mobile Web 2.0 learning using qualitative analysis (i.e., thematic analysis); and (ii) the analysis of the developed model using quantitative measures via PLS-SEM. However, this study only focuses on the second part, where the developed model was assessed via quantitative measures using PLS-SEM analysis. The research method implemented in the study is further discussed in the Research Section.

As stated before, the study used the context model of Kofod-Petersen and Cassens (2006) as the basis for analysis. The model is illustrated in Figure 1. Kofod-Petersen and Cassens’ (2006) context model describes user context from five aspects, which are: environmental context, personal context, social context, task context, and spatio-temporal context. The descriptions of the aspects are as the following (Kofod-Petersen and Cassens, 2006):

i. Environmental context covers the users’ surroundings, such as things, services, people, and information accessed by the user;
ii. Personal context describes the mental and physical information about the user, such as mood, expertise and disabilities;
iii. Social context aspects explains the social aspects of the user, such as information about the different roles a user can assume;
iv. Task context explains what the user is doing, it can describe the user’s goals, tasks and activities;
v. Spatio-temporal context consists of time, location and the community present.

![Figure 1: The context model by Kofod-Petersen and Cassens (2006)](image-url)
The Research Model

The research model tested in the study consists of six constructs and 44 respective indicators. The constructs are: (i) learning community awareness; (ii) learning space awareness; (iii) learning reflection awareness; (iv) social awareness; (v) task awareness; and (vi) personal awareness. Learning community awareness has six respective indicators, learning space awareness has seven, learning reflection awareness has eight, social awareness has seven, task awareness has six, and personal awareness has ten. The indicators are summarized in Table 1.

Table 1: The research model’s constructs with their respective indicators

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning community reflection</td>
<td>Peer activity status</td>
<td>Awareness of the past and current activity status of peers</td>
</tr>
<tr>
<td></td>
<td>Peer activity changes</td>
<td>Awareness of the past and current changes of peers’ activity</td>
</tr>
<tr>
<td></td>
<td>Peer activity progress</td>
<td>Awareness of the past and current progress of peer activity</td>
</tr>
<tr>
<td></td>
<td>Peer contribution</td>
<td>Awareness of peer contribution towards learning</td>
</tr>
<tr>
<td></td>
<td>Peer approval</td>
<td>Awareness of the approval of learning task by peers</td>
</tr>
<tr>
<td></td>
<td>Peer location</td>
<td>Awareness of location of peers before, during, and after learning</td>
</tr>
<tr>
<td>Learning space awareness</td>
<td>Information accessed</td>
<td>Awareness of information accessed via learning tools</td>
</tr>
<tr>
<td></td>
<td>Learning tools</td>
<td>Awareness of the learning tools used during learning</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Awareness of the location of learning</td>
</tr>
<tr>
<td></td>
<td>Object in surroundings</td>
<td>Awareness of objects in the learning environment</td>
</tr>
<tr>
<td></td>
<td>Proximity</td>
<td>Awareness of the nearness in relation to the learning site’s location</td>
</tr>
<tr>
<td></td>
<td>Services offered</td>
<td>Awareness of services offered during learning</td>
</tr>
<tr>
<td></td>
<td>Weather</td>
<td>Awareness of weather at the learning location</td>
</tr>
<tr>
<td>Learning reflection awareness</td>
<td>Learning content reflection</td>
<td>Awareness of reflection on learning content provided to them via learning tools</td>
</tr>
<tr>
<td></td>
<td>Learning outcome reflection</td>
<td>Awareness of reflection on learning outcomes during learning</td>
</tr>
<tr>
<td></td>
<td>Learning progress reflection</td>
<td>Awareness of reflection on learning progress</td>
</tr>
<tr>
<td></td>
<td>Own work reflection</td>
<td>Awareness of reflection on a student’s own work</td>
</tr>
<tr>
<td></td>
<td>Peer work reflection</td>
<td>Awareness of peer reflection on a student’s work</td>
</tr>
<tr>
<td></td>
<td>Own group reflection</td>
<td>Awareness of own group reflection on a students’ work</td>
</tr>
<tr>
<td></td>
<td>Non-group reflection</td>
<td>Awareness of non-group reflection on a students’ work</td>
</tr>
<tr>
<td></td>
<td>Facilitator reflection</td>
<td>Awareness of facilitator’s reflection on a student’s work</td>
</tr>
<tr>
<td>Social awareness</td>
<td>Role in groups</td>
<td>Awareness of the individual roles in teams according to the learning tasks</td>
</tr>
<tr>
<td>Self-expectation</td>
<td></td>
<td>Awareness of self-expectation before, during or after learning</td>
</tr>
<tr>
<td>Peer expectation</td>
<td></td>
<td>Awareness of peer’s expectation before, during or after learning</td>
</tr>
<tr>
<td>Peer interaction</td>
<td></td>
<td>Awareness of peer interaction during learning</td>
</tr>
<tr>
<td>Construct</td>
<td>Indicator</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Peer feedback</td>
<td>Awareness of peer feedback during learning</td>
<td></td>
</tr>
<tr>
<td>Facilitator</td>
<td>Awareness of facilitator expectation before, during or after learning</td>
<td></td>
</tr>
<tr>
<td>expectation</td>
<td>Facilitator interaction</td>
<td>Awareness of facilitator expectation before, during or after learning</td>
</tr>
<tr>
<td>Task awareness</td>
<td>Planning</td>
<td>Awareness of “plans related to learning tasks” made in the group</td>
</tr>
<tr>
<td></td>
<td>Task distribution</td>
<td>Awareness of task distributed among group members</td>
</tr>
<tr>
<td></td>
<td>Task goal</td>
<td>Awareness of the tasks’ aim before conducting a particular task</td>
</tr>
<tr>
<td></td>
<td>Task structure</td>
<td>Awareness of task structure/steps to complete a task</td>
</tr>
<tr>
<td>Learning material</td>
<td>Awareness of learning material available to complete a task</td>
<td></td>
</tr>
<tr>
<td>Time availability</td>
<td>Awareness of time available to complete a task</td>
<td></td>
</tr>
<tr>
<td>Personal awareness</td>
<td>Confidence</td>
<td>Awareness of self-confidence state during learning</td>
</tr>
<tr>
<td></td>
<td>Effort</td>
<td>Awareness of efforts contributed during learning</td>
</tr>
<tr>
<td></td>
<td>Motivation</td>
<td>Awareness of self-motivation state during learning</td>
</tr>
<tr>
<td></td>
<td>Satisfaction</td>
<td>Awareness of self-satisfaction state during learning</td>
</tr>
<tr>
<td></td>
<td>Self-improvement</td>
<td>Awareness of self-improvement state during learning</td>
</tr>
<tr>
<td>Privacy</td>
<td>Awareness of privacy level during learning</td>
<td></td>
</tr>
<tr>
<td>Anxiety</td>
<td>Awareness of anxiety state during learning</td>
<td></td>
</tr>
<tr>
<td>Confusion</td>
<td>Awareness of confusion state during learning</td>
<td></td>
</tr>
<tr>
<td>Diffidence</td>
<td>Awareness of diffidence state during learning</td>
<td></td>
</tr>
</tbody>
</table>

The constructs of the research model are derived based on the construct of the context model of Kofod-Petersen and Cassens (2006). The context model consisted of five constructs. Qualitative analysis was conducted via thematic analysis using the context model. As a result, six constructs seemed to emerge from the analysis. Three of the constructs (social awareness, task awareness, personal awareness) seemed to confirm with the constructs of the context model (social context, task context, personal context). Two other constructs seemed to be related to the environmental context and spatio-temporal context of the context model. However, the two constructs seemed to be better represented by the terms “learning space awareness” and “learning community awareness” respectively. Interestingly, one new theme seemed to emerge from the data. The theme is learning reflection awareness. Hence, the findings produced the research model consisting of six constructs and 44 respective indicators (see Figure 2).
Situation awareness and learning community awareness

Belkadi et al. (2012) posit that the concepts of a community are essential to assist team collaborators to anticipate each other’s reactions in collaborative work. This can further be linked to the concept of “community of practice” and “situated learning”, as the learner is involved in interacting with community members and participates in shared activity in a community (Aadal et al., 2013; Lave and Wenger, 1991). This in turn causes the learning community to develop a “shared knowledge bank” of learning experiences, stories, tools and methods of overcoming recurring learning problems as a result of members who have been a part of the community for a longer period (Wenger et al., 2009; Aadal et al., 2013). For the new learners, they exploit the community’s “shared knowledge bank” with the aim of “mastering new understandings” (Lave and Wenger, 1991; Aadal et al., 2013). The learning community can further promote learner engagement in the learning community, and reach a sufficient level of understanding to participate in the learning practices, thus making learning more meaningful (Wenger et al., 2009). Thus, with respect to the research model, learner situation awareness is expected to be influenced by learning community awareness.

Situation awareness and learning space awareness

Janssen and Bodemer (2013) discovered that problems existing in the workspace or “learning space” are more obvious in online learning environments than in face-to-face environments as online learning environments offer less perceptual information. They explained that perceptual information refers to current status of group tasks, contribution of group members to the group process, behavioral and social activities, as well as skills and knowledge possessed by team members. The authors also stated that when students are unaware of their team members’ status, this might accidently cause duplication of learning tasks and demotivate students. As a result, when students have learning space awareness, it can assist them in coordinating their actions, enhance their productivity, and reduce their chances of errors (Gutwin and Greenberg, 2004; Janssen and Bodemer, 2013). Kofod-Petersen and Cassens (2006) noted that the environment context influences context awareness in working environments. They found that the environment context is influenced by the elements in users’ surroundings such as objects, services, people, and user accessed information. This can be somewhat mapped to learning space context as learners gain information from the surroundings in learning situations. Hence, in the research model, learner situation awareness is expected to be influenced by learning space awareness.
Situation awareness and learning reflection awareness

Yang (2010) developed a learning system to investigate learning reflection awareness – whether self-assessment and peer assessment influenced writing skills. The author discovered that peer assessment had a significant impact on enhancing writing skills. This can be somewhat related to learning reflection awareness because as students became aware of their mistakes as highlighted by their peers, it caused them to increase their self-awareness on improvements. In relation, Phielix et al. (2011) discovered that students learn by reflecting on peer feedback. By conducting reflections, students are engaged in cognitive and affective activities in reaching new understandings of their learning experiences. This can lead to learner situation awareness where learners become more aware of their own actions and behavior, how it affects their peers, and whether they should change their action and behaviors to achieve their individual and group learning goals. Thus, in the research model, learner situation awareness is expected to be influenced by learning reflection awareness.

Situation awareness and social awareness

A key element in successful collaborative learning is the element of social interaction that includes cognitive processes (i.e., task-related processes) such as discussion, reasoning, reflection, and critical thinking, as well as social processes (i.e., non-task related processes) such as cohesiveness and trust (Kreijns et al., 2003; Phielix et al., 2011). These processes enable group members to know and understand each other in collaboratively performing tasks, solving problems or constructing new knowledge (Gunawardena, 1995; Jonassen, 2000; Kreijn et al., 2003; Phielix et al., 2011). This can be related to the concept of “role in groups” within collaborative teams as suggested by Belkadi et al. (2012), where they emphasized that this concept is useful in understanding relationships within collaborative teams. They also explained the “role” concept as suggested by several authors (Detienne, 2006; Garrido et al., 2007; Van der Aalst and Kumar, 2001), in which the emphasis was on factors relating to an individual’s characteristic and appropriate time in implementing the concept. The authors stated that the “role in groups” concept depends on the abilities, expertise, and skills of collaborators in a team. For successful collaborative tasks, it is essential that the “team leader” recognizes the team members’ abilities, expertise, and skills and maps them appropriately with roles the individual can perform. Hence, the research model suggests that learner situation awareness is expected to be influenced by social awareness.

Situation awareness and task awareness

Covertino et al. (2004) described task awareness as collaborators’ ability to understand the “overall picture” on ongoing team tasks/activities as well as other teams’ tasks in the projects. Meanwhile, Borges et al. (2005) modeled situation and awareness in teamwork. The authors emphasized that task awareness is affected by relationships between team members and interactions among them. They also suggested that the environment as well as scheduled and completed tasks impact task awareness. Detienne (2006) claimed that action awareness is closely related to task awareness; the concept of “action awareness” is related with the state of team members’ contribution and task-oriented artifacts with awareness of task members’ understanding and plans. Belkadi et al. (2012) however argue that the relationship proposed by Detienne (2006) is valuable but it is hardly applicable as the concepts of situation and action are closely related to one another, because an action of a team member would have significant effects on other team members. They also believed that each collaborator in a group interacts with other collaborators or resources in order to achieve task aims. As such, Belkadi et al. (2012) concluded that situation awareness is related to task awareness since a collaborator’s situation awareness depends on making decisions in collaborative situations based on what other collaborators are effectively doing. They also emphasized that a lack of situation awareness is likely to lead to negative group level impacts. Therefore, in the research model, learner situation awareness is expected to be influenced by task awareness.

Situation awareness and personal awareness

The Kofod-Petersen and Cassens (2006) study used the activity theory in modeling “contexts” or “situations” of artificial or real agents in a pervasive computing environment. They claimed that one of the factors influencing “context” is the personal aspect. This is related to the mental and physical information about the user. Hence, in the research model, learner situation awareness is expected to be influenced by
personal awareness.

**Research hypotheses**

From the previous discussions, the following research hypotheses are proposed:

Hypothesis 1: Learner situation awareness is reflected by learning community awareness.

Hypothesis 2: Learner situation awareness is reflected by learning space awareness.

Hypothesis 3: Learner situation awareness is reflected by learning reflection awareness.

Hypothesis 4: Learner situation awareness is reflected by social awareness.

Hypothesis 5: Learner situation awareness is reflected by task awareness.

Hypothesis 6: Learner situation awareness is reflected by personal awareness.

**Research method**

**Respondent background**

The respondents were 71 novice teacher trainees (10 male, 61 female) taking an educational technology course in a local university. The teacher trainees had limited background in technology usage for teaching. The average age of the respondents was 22 years. They had limited or negligible experience in using video technology for instructional purposes. The educational technology course was carried out in a blended learning environment integrating both face-to-face mode for course lectures as well as mobile Web 2.0 learning mode. The course aim was to develop the trainees’ technology usage skills, particularly video production and social media use (i.e., Facebook, blog, and mobile augmented reality), for future teaching purposes.

**Data collection procedure**

The study was conducted over four months in an educational technology course. The course was conducted via a video production module integrated into the course. It was conducted in blended learning mode. In each module session, 30-minute face-to-face lectures were given. The learning activities were conducted after the lectures, in one-and-half hour sessions. The instruction was conducted as the following: (i) students were divided into groups of five or six students; (ii) each group produced a 5-minute video on an open topic collaboratively; (iii) students were encouraged to discuss their learning activities collaboratively with group members in the mobile Web 2.0 learning environment; (iv) students were encouraged to conduct reflections of learning cooperatively in the learning environment; and (v) students were provided with mobile augmented reality to assist them in locating learning sites.

A mobile Web 2.0 learning environment was developed and provided to the students to: (i) facilitate online discussions among them inside and outside the classroom; and (ii) provide them with additional online learning material (e.g., course moblog on video production methods). The students were also encouraged to discuss their work in “open” and “closed” groups on the social media platform (explained further in a later section) in line with Aydin (2012), where a social platform can be implemented as an educational environment. “Open” groups refer to groups in which the discussions are open to the public or to a larger group of people, whereas “closed” groups refer to a smaller group where discussions are “closed” within the group. In addition, the students were assigned to produce “individual” and “group” moblogs to reflect on their learning. Mobile augmented reality technology was also provided to assist students in retrieving location-based information for their tasks (i.e., search for learning sites to assist in task completion). The technology helped them in terms of augmented information (e.g., history of building or location), exact position of point-of-interest (e.g., GPS coordinates of interesting place), as well as additional information of location (e.g., pictures taken by users who have been to location before them).

**Data analysis procedure**

*Data procedure for identification of research model’s constructs and indicators*

This study is a part of a larger study aimed at modelling learner situation awareness in collaborative mobile Web 2.0 learning. In the larger study, the data analysis conducted is a qualitative analysis via thematic
analysis, video interviews and inter-rater reliability analysis. A mobile Web 2.0 learning environment, called Mobi2Learn, was designed iteratively with expert consensus using the participatory design approach. Using thematic analysis (Braun and Clarke, 2006), the themes and sub-themes that seemed to be related to learner situation awareness were coded from social networking sites and moblog transcripts. The coding was conducted using NVivo version 8.0. Data triangulation was then conducted via video interviews with 21 participants to gain more information about the coded themes. The themes and sub-themes coded were then analyzed via inter-rater reliability analysis using two inter-raters to ensure the sub-themes were representative of each theme.

**Data procedure for investigation of research model reliability, validity and relationships between constructs and indicators**

The main aim of this study is to investigate the validity and reliability of the research model (identified in the larger study) as well as verify the relationships between the new constructs and their respective indicators. As such, an online questionnaire was distributed to 71 students who have completed the educational technology course. The questionnaire consisted of questions that required pre-determined responses. The measurement scale used was a five-point integer scale. This was because interval-level scales have equidistant intervals – in other words, the scale consists of the rank of a particular score and provides measures indicating how much greater or less a score is compared to another (Treiblmaier and Filzmoser, 2011). The questionnaire design was based on the research model. The questionnaire was then run through the content validation procedure to increase its validity. Two educational technology lecturers, two IT experts, and a language lecturer conducted validation on pedagogical, technological, language and measurement aspects of the questionnaire to confirm the questions for each variable were clear and concise. As a result, the questionnaire consisted of 56 items as measurements. The questionnaire was designed based on Belkadi et al. (2012), Cochrane (2013), Yang (2010), and Kofod and Petersen’s (2006) research.

PLS-SEM was used to analyze the responses to the online questionnaire. PLS-SEM was chosen for data analysis because it can be used to develop theories or models in exploratory research (Hair et al., 2014). Moreover, Hair et al. (2014) adds that it is recommended to use PLS-SEM when the main aim of the research is to conduct predictions and explanations of target constructs. In relation, Chin (1998) explains that PLS-SEM is capable of predicting the formations of individual constructs (i.e., indicators related to each individual construct) and identifies relationships among the constructs (Chin, 1998). In other words, PLS-SEM can verify that the research model is valid and reliable as well as explore the relationships in a structural model. In terms of sample size and model complexity, PLS-SEM is capable of handling small sample sizes and complex models as the technique does not make any assumptions about the underlying data (Hair et al., 2014; Lee et al., 2007).

The PLS-SEM analysis consisted of two types of analysis, which were measurement model analysis and structural model analysis. The measurement model analysis consisted of three tests: (i) internal consistency reliability; (ii) convergent validity; and (iii) discriminant validity. The structural model analysis consisted of two tests: (i) structural model path coefficients; and (ii) coefficient of determination, $R^2$ values. These analyses were conducted in two PLS-SEM analysis rounds. The results are discussed in the Results section.

**Mobi2Learn: The mobile web 2.0 learning environment**

In order to assess mobile Web 2.0 learning, a mobile Web 2.0 learning environment, called Mobi2Learn was developed, as illustrated in Figure 3.
Figure 3. The mobile Web 2.0 learning environment called Mobi2Learn

The Mobi2Learn environment consists of two main components for teaching and learning content production, which are: the platform for facilitator-generated content, and the platform for student-generated content.

Platform for facilitator-generated content

The platform consists of the course moblog, as well as lectures and tutorials. The course moblog was developed as a guide for students to produce their video. Lectures and tutorials slides were provided to the students in the course moblog (for review on moblogs, refer to Norman et al., 2014).

Platform for student-generated content

The platform consists of the project work, tools for collaboration, tools for reflection, and tool for information retrieval.

Project work

Project work contained cases for learning and student-generated videos. As discussed before, cases for learning were the aim of the group task and student-generated videos were the products that students had to produce to reach the aim of the tasks.

Tools for collaboration

Students were provided with open and closed Facebook Groups to collaborate and conduct discussions among them. In open Facebook Groups, the communications among students and instructors are “public” to the whole class but restricted to access from the outside community. In closed Facebook Groups, groups are created based on students’ grouping (teams) according to the course project. This medium allows for more “private” discussions between team members as ideas and comments are shared within the team nucleus only.

Tools for reflection

Students were also provided with moblog technology. Individual reflection moblogs allowed students to maintain records of their individual reflections on learning experiences, acquired skills, learning progress, and views on the learning module. Group reflection moblogs allowed student groups to create reflections of
their own group.

Tools for information retrieval

Students were provided with mobile augmented reality technology to assist them in accessing location-based information.

RESULTS

The PLS-SEM analysis was conducted in two rounds. In the first round, the findings indicated inadequate results for the measurement model analysis tests, illustrated in Figure 4. As a result, 11 indicators were dropped because of inadequacies in internal consistency reliability, convergent validity, and discriminant validity. The indicators are: peer approval, proximity, weather, learning content reflection, facilitator reflection, facilitator expectation, planning, expectation, anxiety, diffidence, and privacy.

The second round of PLS-SEM produced the revised learner situation awareness model for mobile Web 2.0 learning. The revised research model consisted of six constructs and 33 respective indicators. The results of the second round of PLS-SEM data analysis are explained according to: the reflective measurement model analysis, and the structural model analysis.

Reflective measurement model analysis: Internal consistency reliability

The study conducted the reflective measurement model analysis for assessing the reliability and validity using three tests, which are: (i) internal consistency reliability; (ii) convergent validity; and (iii) discriminant validity. The results of the tests are discussed in the following paragraphs.

Internal consistency reliability was conducted to assess the consistency of the instruments’ measures towards the learner situation awareness constructs (Hair et al., 2014; Sekaran and Bougie, 2010). The analysis involved investigation of composite reliability (CR) values. The cut-off value for CR is 0.7, where 0.7 is considered acceptable by Fornell and Larcker (1981). The results of the internal consistency reliability test are summarized in Table 2. From the table, it can be seen that all alpha values are approximately .8 as suggested by Nunnally and Berstein (1994). The composite reliability values also ranged from .837 to .934, which suggest acceptability. From these results, we can conclude that the constructs of the learner situation awareness model are reliable.
Table 2: Internal consistency reliability

<table>
<thead>
<tr>
<th>Construct</th>
<th>AVE</th>
<th>CR</th>
<th>$R^2$</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning community</td>
<td>0.678</td>
<td>0.912</td>
<td>0.500</td>
<td>.877</td>
</tr>
<tr>
<td>Learning reflection</td>
<td>0.703</td>
<td>0.934</td>
<td>0.779</td>
<td>.915</td>
</tr>
<tr>
<td>Learning space</td>
<td>0.593</td>
<td>0.878</td>
<td>0.596</td>
<td>.826</td>
</tr>
<tr>
<td>Personal</td>
<td>0.652</td>
<td>0.918</td>
<td>0.662</td>
<td>.892</td>
</tr>
<tr>
<td>Social</td>
<td>0.526</td>
<td>0.868</td>
<td>0.594</td>
<td>.814</td>
</tr>
<tr>
<td>Task</td>
<td>0.508</td>
<td>0.837</td>
<td>0.619</td>
<td>.760</td>
</tr>
</tbody>
</table>

Reflective measurement model analysis: Convergent validity

Convergent validity analysis was conducted to assess (Hair et al., 2014): “the extent to which a measure correlates positively with alternate measures of the same construct.” It was assessed via: (i) assessment of factor loadings, (ii) composite reliability (CR); and (iii) average variance extracted (AVE) (Hair et al., 2014).

First, loadings were checked to identify whether there were problems with any particular items (Hair et al., 2014; Ramayah et al., 2011). Table 3 shows the results of the loadings of the indicators related to their respective constructs (LC for learning community, LR for learning reflection, LS for learning space, P for personal, S for social, and T for task awareness). All loadings exceeded the cut-off values of 0.5 signifying that the indicators are related to their respective constructs.

Next, the CR and AVE value were accessed. The cut-off values for CR were 0.7 and above (Hair et al., 2014), and values exceeding 0.5 for AVE (Barclay et al., 1995). In Table 3, all the items for CR exceeded the recommended value of 0.7. The AVE for all the constructs was above the recommended value of 0.5, where Barclay et al. (1995) recommended that AVE values be larger than 0.50 to justify using a construct. Thus, the results confirm convergent validity.

Table 3: Convergent validity

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicator</th>
<th>Loading</th>
<th>AVE</th>
<th>CR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning community</td>
<td>LC1_Peer_contribution</td>
<td>0.892</td>
<td>0.678</td>
<td>0.912</td>
</tr>
<tr>
<td></td>
<td>LC2_Peer_activity_status</td>
<td>0.884</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LC3_Peer_activity_changes</td>
<td>0.830</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LC4_Peer_activity_progress</td>
<td>0.860</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LC5_Peer_location</td>
<td>0.620</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning reflection</td>
<td>LR2_Learning_outcome</td>
<td>0.811</td>
<td>0.703</td>
<td>0.934</td>
</tr>
<tr>
<td></td>
<td>LR3_Learning_progression</td>
<td>0.794</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LR4_Self_reflection</td>
<td>0.891</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LR5_Self_assessment</td>
<td>0.832</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LR6_Peer_reflection</td>
<td>0.873</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LR7_Peer_assessment</td>
<td>0.827</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning space</td>
<td>LS1_Learning_tools</td>
<td>0.779</td>
<td>0.593</td>
<td>0.878</td>
</tr>
<tr>
<td></td>
<td>LS2_Information_accessed</td>
<td>0.825</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LS3_Services_provided</td>
<td>0.879</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LS4_Location</td>
<td>0.680</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LS5_Object_in_surroundings</td>
<td>0.665</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>P2_Effort</td>
<td>0.745</td>
<td>0.652</td>
<td>0.918</td>
</tr>
</tbody>
</table>
Reflective measurement model analysis: Discriminant validity

The discriminant validity analysis was aimed at indicating that constructs of the model are unique and captured the phenomenon that is not captured by other constructs (Hair et al., 2014). As such, two tests were implemented: (i) cross loading assessment; and (ii) Fornell-Larcker criterion. In the cross loadings assessment, loadings of constructs’ indicators should load more strongly/higher on their own constructs rather loadings on other constructs (Hair et al., 2014). In the Fornell-Larcker criterion, the square root of AVE value is compared with the latent variable correlations. This shows that a construct shares more variance with its own indicators as compared to any other construct (Hair et al., 2014).

First, cross loadings were checked to identify whether there were problems with any particular items (Hair et al., 2014; Ramayah et al., 2011). Table 4 shows the results of the loadings of the items related to their respective constructs (LC for learning community, LR for learning reflection, LS for learning space, P for personal, S for social, and T for task awareness).

Table 4: Discriminant validity (loadings and cross loadings)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Learning community</th>
<th>Learning reflection</th>
<th>Learning space</th>
<th>Personal</th>
<th>Social</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>LC1_Peer_contribution</td>
<td>0.892</td>
<td>0.510</td>
<td>0.394</td>
<td>0.399</td>
<td>0.626</td>
<td>0.464</td>
</tr>
<tr>
<td>LC2_Peer_activity_status</td>
<td>0.884</td>
<td>0.423</td>
<td>0.379</td>
<td>0.400</td>
<td>0.580</td>
<td>0.487</td>
</tr>
<tr>
<td>LC3_Peer_activity_changes</td>
<td>0.830</td>
<td>0.372</td>
<td>0.383</td>
<td>0.319</td>
<td>0.594</td>
<td>0.401</td>
</tr>
<tr>
<td>LC4_Peer_activity_progress</td>
<td>0.860</td>
<td>0.402</td>
<td>0.357</td>
<td>0.327</td>
<td>0.585</td>
<td>0.408</td>
</tr>
<tr>
<td>LC5_Peer_location</td>
<td>0.620</td>
<td>0.260</td>
<td>0.363</td>
<td>0.187</td>
<td>0.434</td>
<td>0.439</td>
</tr>
<tr>
<td>LR2_Learning_outcome</td>
<td>0.323</td>
<td>0.811</td>
<td>0.518</td>
<td>0.630</td>
<td>0.445</td>
<td>0.574</td>
</tr>
<tr>
<td>LR3_Learning_progression</td>
<td>0.426</td>
<td>0.794</td>
<td>0.460</td>
<td>0.637</td>
<td>0.437</td>
<td>0.434</td>
</tr>
<tr>
<td>LR4_Self_reflection</td>
<td>0.343</td>
<td>0.891</td>
<td>0.495</td>
<td>0.675</td>
<td>0.515</td>
<td>0.498</td>
</tr>
<tr>
<td>LR5_Self_assessment</td>
<td>0.345</td>
<td>0.832</td>
<td>0.558</td>
<td>0.606</td>
<td>0.428</td>
<td>0.379</td>
</tr>
<tr>
<td>LR6_Peer_reflection</td>
<td>0.445</td>
<td>0.873</td>
<td>0.465</td>
<td>0.586</td>
<td>0.500</td>
<td>0.558</td>
</tr>
<tr>
<td>LR7_Peer_assessment</td>
<td>0.546</td>
<td>0.827</td>
<td>0.527</td>
<td>0.596</td>
<td>0.586</td>
<td>0.638</td>
</tr>
<tr>
<td>LS1_Learning_tools</td>
<td>0.503</td>
<td>0.565</td>
<td>0.779</td>
<td>0.534</td>
<td>0.484</td>
<td>0.482</td>
</tr>
<tr>
<td>LS2_Information_accessed</td>
<td>0.427</td>
<td>0.440</td>
<td>0.825</td>
<td>0.496</td>
<td>0.343</td>
<td>0.483</td>
</tr>
</tbody>
</table>
Cut-off values of 0.5 for cross loadings are considered significant (Chin, 1998). From Table 4, all of the items measuring a particular construct loaded highly on their respective constructs (values in bold color) and loaded lower on other constructs. Thus, the findings indicate that the model confirmed discriminant validity.

Next, we proceed with the Fornell-Larcker criterion assessment. The test is conducted by assessment of correlations between measures of potentially overlapping constructs (Hair et al., 2014; Ramayah et al., 2011). In the tested model, items should load more strongly on their own constructs. The values of average variance shared between each construct and its measures should also be larger than the variance between the construct and other constructs (Compeau et al., 1999). As such, the discriminant validity was assessed for each construct of the model. Table 5 indicates that the squared correlations for each construct are less than the AVE by the indicators measuring that construct thus confirming adequate discriminant validity.

### Table 5: Discriminant validity (Fornell-Larcker criterion)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Learning community</th>
<th>Learning reflection</th>
<th>Learning space</th>
<th>Personal</th>
<th>Social</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning community</td>
<td>0.824</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning reflection</td>
<td>0.486</td>
<td>0.839</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning space</td>
<td>0.454</td>
<td>0.601</td>
<td>0.770</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>0.405</td>
<td>0.741</td>
<td>0.611</td>
<td>0.807</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social</td>
<td>0.589</td>
<td>0.476</td>
<td>0.468</td>
<td>0.725</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task</td>
<td>0.533</td>
<td>0.617</td>
<td>0.544</td>
<td>0.566</td>
<td>0.713</td>
<td></td>
</tr>
</tbody>
</table>

**Structural model analysis: Structural model path coefficients**

The structural model path coefficients test (or hypotheses tests) was conducted to examine the
the hypothesized relationships among the constructs. The significance of the path coefficients was assessed via bootstrapping where the bootstrapping standard error allows for the empirical t value to be calculated (Hair et al., 2014). The criterion is that if the empirical t value is larger than the critical value, the coefficient is considered “significant” at a certain error probability level or significance level (Hair et al., 2014). The common critical values for two-tailed tests are 1.65 (significance level = 10%), 1.96 (significance level = 5%), and 2.57 (significance level = 1%). In this test, six research hypotheses (i.e., relationship between low-order models and higher order models) were assessed via assessment of their empirical t value against the critical values for two-tailed tests.

Figure 4. The revised research model after removal of indicators (PLS-SEM second round – results of structural model path coefficient)

Table 6: Structural model path coefficients (hypotheses testing)

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>$R^2$</th>
<th>Beta</th>
<th>Standard Error</th>
<th>t-value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situation awareness -&gt; Learning community</td>
<td>0.500</td>
<td>0.707</td>
<td>0.079</td>
<td>8.960*</td>
<td>Supported</td>
</tr>
<tr>
<td>Situation awareness -&gt; Learning reflection</td>
<td>0.779</td>
<td>0.883</td>
<td>0.030</td>
<td>29.507*</td>
<td>Supported</td>
</tr>
<tr>
<td>Situation awareness -&gt; Learning space</td>
<td>0.596</td>
<td>0.772</td>
<td>0.048</td>
<td>16.209*</td>
<td>Supported</td>
</tr>
<tr>
<td>Situation awareness -&gt; Personal</td>
<td>0.662</td>
<td>0.814</td>
<td>0.044</td>
<td>18.699*</td>
<td>Supported</td>
</tr>
<tr>
<td>Situation awareness -&gt; Social</td>
<td>0.594</td>
<td>0.771</td>
<td>0.059</td>
<td>13.103*</td>
<td>Supported</td>
</tr>
<tr>
<td>Situation awareness -&gt; Task</td>
<td>0.619</td>
<td>0.787</td>
<td>0.049</td>
<td>15.988*</td>
<td>Supported</td>
</tr>
</tbody>
</table>

**p < .01, * p < .05**
The results of the structural model path coefficient test are shown in Figure 4 and Table 6. Based on Table 6, all the t values exceeded the critical values of 2.57 (Hair et al., 2014) indicating that learner situation awareness in collaborative mobile Web 2.0 learning is significantly reflected by six constructs which are learning community awareness, learning space awareness, learning reflection awareness, personal awareness, social awareness, and task awareness. Thus, the findings supported all six hypotheses.

**Structural model analysis: Coefficient of determination, \( R^2 \)**

The second structural model analysis is the \( R^2 \) (coefficient of determination) values of the structural model were. Higher values indicate that the observed values were substantially replicated by the model, while lower values indicate that the observed values were weakly replicated by the model (Hair et al., 2014). The rules of thumb for \( R^2 \) values suggested by Hair et al. (2014) are: (i) \( R^2 \approx 0.75 \) is considered “substantial”; (ii) \( R^2 \approx 0.50 \) is considered “moderate”; and (iii) \( R^2 \approx 0.25 \) is considered “weak.”

Referring to \( R^2 \) values in Figure 5, the following can be concluded: (a) learning community awareness is reflected by ~50% of the total variance of learner situation awareness; (b) learning space awareness is reflected by ~60% of the total variance of learner situation awareness; (c) learning reflection awareness is reflected ~78% of the total variance of learner situation awareness; (d) personal awareness is reflected by ~67% of the total variance of learner situation awareness; (e) task awareness is reflected by ~62% of the total variance of learner situation awareness; and (f) social awareness is reflected by more than 60% of the total variance of learner situation awareness for collaborative mobile Web 2.0 learning.

![Figure 5. The results of coefficient of determination \( (R^2) \) test.](image)

As such, two constructs, which are learning reflection awareness and personal awareness, were “substantially” replicated by the model. The other remaining constructs, task awareness, learning space awareness, learning community awareness, and social awareness were “moderately” replicated by the model. In sum, as the research model explained more than 60% of the total variance in learner situation awareness, the research model has a good predictability and explanatory power for learner situation awareness in collaborative mobile Web 2.0 learning.

**DISCUSSION**

Reflective measurement model analysis
The results of the reflective measurement model analysis via three tests (internal consistency reliability, convergent validity, discriminant validity) confirm that the refined research model is valid and reliable. The results also indicated that there are 33 indicators that reflect the six constructs of the refined research model as compared to the original 44 indicators. The indicators suggested for removal are: (i) peer approval from learning community awareness; (ii) proximity and weather from learning space awareness; (iii) learning content reflection and facilitator reflection from learning reflection awareness; (iv) facilitator expectation from social awareness; (v) planning from task awareness; and (vi) expectation, anxiety, diffidence, and privacy from personal awareness. However, we argue that these indicators could still be useful in studying learner situation awareness in collaborative mobile Web 2.0 learning. The following discusses the rationale for their inclusion.

It was recommended that peer approval be removed from learning community awareness. We deemed this to be an important factor due to the fact that students in social networking Groups were observed to seek peer approval of their work and contribution towards the group. It seemed that as students gained peer approval from their team members, they felt a sense of inclusion towards the team, in this case, the small-sized learning community. This further contributes to the fact that before students make decisions to proceed in conducting/finishing a learning task, they would seek peer approval in order to gain a team consensus/perception of their work. This can be linked to findings by Dabbagh and Kistantas (2012) indicating that peer feedback is an important aspect for personalized formal and informal learning.

For learning space awareness, Proximity and weather were recommended to be removed. However, both of the sub-themes are important for inclusion in the research model because information on proximity and weather assisted students to be aware of the situation of the learning space. In fact, awareness of these indicators helped them to make decisions on whether or not to visit the location sites suggesting that proximity and weather play important roles in the decision-making process in collaborative mobile Web 2.0 learning. This corroborates with the work of Kiani et al. (2013), where they reported that proximity is an important factor in cross-team collaborations.

Learning content reflection and facilitator reflection were suggested to be removed from learning reflection awareness. We also argue that both of these indicators are important. The rationale for their inclusion can be linked to state of reflection-in-action and reflection-on-action reported in the work of Yang (2010). With regard to reflection-on-action, students reflected on learning content and facilitator reflection after completing their learning tasks. Reflection on the learning content and facilitator reflection coincidentally contributed to the awareness of their learning progress. These reflections-on-action further contributed to the future reflections-in-action. As students proceeded to a future learning task, the reflections-on-action of learning content and facilitator reflection gained before, coincidentally assisted the students in being more informed (by previous learning reflections) about making new decisions in the learning tasks (Yang, 2010).

For social awareness, the facilitator expectation indicator was recommended to be removed from the research model. Again, we emphasize the rationale behind the importance of including this indicator. In virtual and physical spaces, we observed that students made decisions based on what facilitators expected of them (e.g., produce learning products). It seemed that facilitator expectation made students become aware of their learning goals and further helped them in making decisions in learning; this can be linked to Oncu and Cakir’s (2011) work where they studied peer response with regard to learner expectation.

For task awareness, planning was suggested to be removed. To better visualize the importance of this indicator, we illustrate the scenario with the following example. It was noticed that students during learning tasks seemed to plan their learning activities according to the time available to them. When they became aware of the plans of the team members and time available for them to complete the tasks, it seemed that the students gained a “collaborative mutual understanding” of what they had to perform in order to complete their learning tasks, thus influencing their decision-making. This is corroborated by Janssen et al. (2012) indicating that the aspects of planning and monitoring are important in collaborative online learning.

For personal awareness, four indicators were recommended to be dropped. Here, we can see that the four indicators were negative personal aspects (confusion, anxiety, diffidence, privacy). The indicators could be useful for investigating personal awareness (refer to Liaw and Huang (2013) for negative emotional
conditions such as perceived anxiety). Patterns of confusion, anxiety and diffidence were observed when students faced problems in conducting learning tasks. As they exhibited patterns of confusion, anxiety and diffidence, it seemed that the students became more aware that they were incapable of finishing a learning task. For example, when a student was confused, it seemed to have led to increased levels of anxiety and diffidence further leading to poor decision making. This might have even caused students to express concern for privacy, which was noticed as students used private messages to communicate among themselves.

### Structural model analysis

The results revealed that all the research hypotheses were supported. This indicates that learner situation awareness in collaborative mobile Web 2.0 learning is reflected by six constructs. The constructs are learning community awareness, learning space awareness, learning reflection awareness, social awareness, task awareness, and personal awareness.

Furthermore, the $R^2$ values showed that learner situation awareness is “substantially” reflected by learning reflection awareness because it represented ~78% of the total variance. This infers that learning reflection awareness could be an essential factor in understanding learner situation awareness in collaborative mobile Web 2.0 learning. The results can be related to the findings of Phielix et al. (2011) suggesting that peer reflection could enhance learning in a CSCL environment. This implies that peer reflection could be used to increase learner situation awareness as learners become aware of their own learning as well as their peer’s learning resulting in gaining of new understandings. Moreover, these results also can also be related to Yang’s (2010) findings indicating that self-assessment and peer assessment could be utilized by educators in promoting students to be more aware of mistakes and encouraging them to increase their awareness on self-improvement.

The $R^2$ values also showed that personal awareness is “substantially” replicated in the model (~67%). This indicates that personal awareness is also an important factor in understanding learner situation awareness in collaborative mobile Web 2.0 learning. An interesting perspective on personal context can be viewed from Chang et al.’s (2012) study on English mobile learning systems. They investigated the students’ acceptance of mobile learning system by assessing relationships between perceived ease of use, playfulness, usefulness, convenience, and continuance intention. They discovered that most of the relationships have positive correlations with one another, with the exception of the perceived convenience-continuance intention relationship. It is worth noting that these elements could also be considered when conducting investigation on the personal context as they could influence learner mental state.

The results also indicated that four constructs “moderately” reflected learner situation awareness in collaborative mobile Web 2.0 learning. The constructs are task awareness (~62% of the total variance of learner situation awareness), learning space awareness (~60%), social awareness (~60%), and learning community awareness (~50%). These results can be linked to studies by Belkadi et al. (2012), Janssen and Bodemer (2013) and Schuck et al. (2013).

For task awareness, it may be concluded that learners in a group are likely to make a decision based on the tasks given to them. The scenario is evident in this study in reflections of students in moblogs. Reflections in moblogs seemed to assist students in knowing in-depth which tasks their team members were doing, which tasks they have done, and which tasks that they are going to do. As a result, students increased their task awareness that in turn seem to aid them in coordinating their workflow in which tasks were carried out in two modes: cooperative, and collaborative mode in line with the ideas of Ryberg et al. (2010). In cooperative mode, students conducted their tasks individually and then cooperatively discussed the output with team members. In collaborative mode, they performed group tasks collaboratively at the same time. As both modes assisted teams in conducting collaborative tasks successfully, it would be interesting for educators to investigate which mode is appropriate across learning contexts.

For social awareness, interactions between peers and facilitators are important in understanding a learning situation before making a decision. Nevertheless, although the results suggest that these factors are important, studies have reported that social technology (i.e., implemented in mobile Web 2.0 learning) could have negative effects on learning if not implemented with care (Kreijns et al., 2003; Schuck et al., 2013). Kreijns et al. (2003) stated that although social technology is designed to promote interaction among users,
there are instances where technology can disrupt learning. This happens when educators “consciously” or “unconsciously” take social interaction “for granted” in learning – by perceiving that social technology can promote learning on its own (Kreijns et al., 2003). To ensure that meaningful learning is promoted, social interaction should be intentionally designed for learning (Kreijn et al., 2003; Schuck et al., 2013).

For learning space awareness, it can be inferred that not only do knowledge and behavior aspects impact learning space awareness, the virtual and physical information that exist in the learning space (e.g., images from the surroundings during a learning activity or information that can be accessed via the Internet) may affect learner situation awareness too. Similar to task awareness, learning space awareness could assist students in coordinating their activities, and reduce chances of errors. Janssen and Bodemer (2013) discovered that increasing students’ awareness in the learning space could reduce duplication of learning tasks conducted by group members, thus avoiding demotivation.

The final remaining construct – learning community awareness – has the least variance among the six constructs (~50%) that reflected learner situation awareness in collaborative mobile Web 2.0 learning. This indicates that the construct is of less importance in learner situation awareness. Interestingly, the results seemed to contradict with the views of Belkadi et al. (2012), where the researchers suggest that community awareness aspects are essential in computer-supported collaborative work (CSCW). Surprisingly, these results are also inconsistent with our initial perception that the a learner in a group is likely to make a decision based on what other group members are doing, have done, and are going to do. These results could be caused by the study’s limitation that restricted the public from accessing the learning community discussions thus causing the discussion to be contained in a “confined” classroom boundary. A more open mode of discussion could have resulted in different findings. Future studies could assess the impact of “open” and “closed” discussion on learner situation awareness. Moreover, the course was conducted in a blended learning environment. This may have been a contributing factor as to why the respondents regarded this construct as the least important. The use of a fully online learning environment could have yielded different results.

CONCLUSION AND IMPLICATIONS

In sum, the findings in the study revealed promising results in understanding learning situation awareness in collaborative mobile Web 2.0 learning. The study produced a learner situation awareness model that consists of six constructs (i.e., learning reflection awareness, learning community awareness, learning space awareness, social awareness, personal awareness, task awareness) and 33 respective indicators. Overall, the revised research model explained learner situation awareness in collaborative mobile Web 2.0 learning.

The model could be used as a foundation for future investigation in fields such as user interface design, pervasive computing, and teaching/learning in collaborative mobile Web 2.0 learning. In terms of user interface design, the research model could be used to design better user interfaces, which suit learners’ needs in order to enhance their learning process. For example, the indicators of the task, social and learning community awareness constructs could be utilized to design user interfaces that could improve coordination of learning tasks within group learning (Khuzaimah et al., 2015; Norman et al., 2015). For pervasive computing, the research model could be beneficial in terms of offering “right time, right place” assistance or solutions. This could be done by mapping the indicators of learning space construct to guide the context-aware information offered to learners during learning. For teaching/learning purposes, educators could use the indicators in the personal awareness construct to assess the emotional state of a learner during learning. For example, indicators such as motivation and confusion could guide educators in designing effective methods to moderate and intervene during the learning process.

Despite the promising results, this study has a few limitations. First, it only focused on learning from the student perspective while the role of the instructor was not investigated in depth. An interesting study would be to investigate the role change of instructors on an instructor-facilitator-peer continuum in which the instructor would have to assume different or combined roles in different learning situations. Second, the research model investigates collaborative mobile Web 2.0 learning in a blended learning course. Investigation
on a fully online learning course could have produced different results. Third, the study focused on learner situation awareness in the domain of educational technology; future research could be carried out in different domains, which may yield promising yet unexpected results. The study was also limited in terms of learners’ expertise as the learners were considered as novice learners. Including intermediate or expert learners could yield in interesting results. Fourth, the quality of learning outcome (i.e., videos) was not measured in the research model. Future studies could address and identify the relationships between such measures and the constructs of the research model. Fifth, the relationships between the constructs in the model were not confirmed with other tests such as the Covariance-based Structural Equation Modelling. Future studies could investigate whether correlations exist between the research model’s constructs and indicators with a larger sample. Sixth, the study was conducted in an Asian context. Educators could study the cultural and social effect of different geographical context on collaborative mobile Web 2.0 learning. The values that certain countries nurture and practice might have a large influence on mobile Web 2.0 learning and its effect on learning and instruction.

ACKNOWLEDGEMENT

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Teaching For Art Criticism: 
Incorporating Feldman’s Critical Analysis Learning Model In Students’ Studio Practice

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ABSTRACT

This study adopted 30 first year graphic design students’ artwork, with critical analysis using Feldman’s model of art criticism. Data were analyzed quantitatively; descriptive statistical techniques were employed. The scores were viewed in the form of mean score and frequencies to determine students’ performances in their critical ability. Pearson Correlation Coefficient was used to find out the correlation between students’ studio practice and art critical ability scores. The findings showed most students performed slightly better than average in the critical analyses and performed best in selecting analysis among the four dimensions assessed. In the context of the students’ studio practice and critical ability, findings showed there are some connections between the students’ art critical ability and studio practice.

Keywords: Art Criticism, Feldman, Critical Analyses, Learning Model, Studio Practice

INTRODUCTION

In current practices of art education, artistic knowledge refers to the ability of art students to handle production issues of art, comprising practical studio work and critical knowledge. From the teaching perspective, the learning of studio practice is delivered through practical subjects dealing directly with disciplines such as drawing, painting, photography, architecture, graphic design, interior design and many more. As for the learning of critical knowledge it is delivered through theoretical subjects such as art history, art appreciation, art criticism and aesthetics. Students reaching proficiency in art should be able to display not only mastery of contents of each component, but also integration of the two components. In other word, apart from being skilful in making art, the students must also be knowledgeable in talking or writing about art.

One of the common approaches to art learning in enhancing students’ critical knowledge is to teach them art criticism. In such an approach, students are not only taught to study the appropriate steps of making criticism but also to apply the proper strategies of making criticism that they can carry directly into their studio practices. As a term, art criticism refers to the process of exercising a serious and objective examination on a work of art and making systematic judgment of it. The art criticism process seeks to inform and educate people (including artists) about art by providing insights into the meaning and significance of artworks. Through art criticism, one is aided in increasing one’s understanding about art, and thus, building a better sense of appreciation toward art by being illuminated with the cultural and societal values, according to what an art work proffers. Although art criticism is still a philosophically contested concept (Geahigan,
1983), it is in a practical sense a linguistic exploration of art works, or a talk about art (Feldman, 1982) in which we discover a deeper meaning of art and clarify our ways of observation when reacting to it. Seeing the virtues of art criticism, especially in the current system of art training, art educators are strongly proposing instruction in art history and art criticism in art classes, in addition to studio practice (Hamblen, 1985).

To be sure art criticism addresses the meaning and significance of works of art. It deals with art in the form of spoken or written discussion in the context relevant to the present necessity (Greer, 1984). The exercise of art criticism by analyzing works of visual art enhances one’s perception and appreciation, deepens one’s feelings for other human beings, and elevates one’s level of humanity. The elements of art criticism, when combined with those of aesthetics, support the development of a commonly known notion called aesthetic experience. This tripartite focus of viewing, understanding and experiencing has a history in the literature of art education dating back more than two decades. Given such an orientation, art criticism is commended in art education literature as a more successful strategy of art teaching than those traditionally used by studio art instructors. For this reason, Barrett (1988), for example, suggests engaging students in descriptive analysis and interpretive argumentation to arrive at more carefully reasoned and more fully argued judgments on a work of art, in a process that can be realized through art criticism. This he contends will give both the teacher and students more to consider and more to talk about visual arts (Barrett, 1988).

In a NAEA Advisory Publication, Tollifson (1990) summarized that writing responses in art criticism provides students with greater depth in learning, allowing them to refine their verbal and perceptual abilities. Besides that, students’ written criticism allows the teacher to provide more detailed guidance, better management and evaluation of critical activities, and assessment of student growth in the art critical process (Johnson and Cooper, 1994, p. 22). The pedagogical function of art criticism, according to a leading art theorist, is to help students participate in [the] chain of looking, seeing, and experiencing, and later to transfer what they have learned to do with art to the world at large (Eisner, 1988, p. 19). Art criticism is important because it provides students with opportunities to learn to perceive, explore and describe their visual world in a highly individual and unique way. Such a process and encounter will inevitably be based on aesthetics (Csikszentmihalyi and Robinson, 1990), the branch of philosophy that deals with the study of beauty.

Art criticism is a vital assessment tool for development and growth in the arts. Art critics analyze, evaluate, interpret and study works of art, translate or articulate the intangible to tangible. Art criticism formats have in common a more or less linear step-by-step approach in which steps build upon each other. Undoubtedly, Feldman’s method consisting of (1) description, (2) formal analysis, (3) interpretation, and (4) judgment has been the most prominent and thoroughly examined art criticism format in art education (Hamblen, 1985). Students of all ages can learn the main concepts of art criticism and apply them when they make oral or written statements about art. They observe, describe, analyze, interpret, and evaluate (Barrett, 1988; Chapman, 1978; Feldman, 1982). They can learn the concepts used in discussing works of art, beginning with descriptions of the sensory properties (line, color, shape, texture, and value), moving to an analysis of the formal properties of the work (balance, rhythm, theme, and variation), interpretation (intrinsic and extrinsic meaning), and finally looking at judgements.

**LITERATURE REVIEW**

**Feldman model (1970)**

The study of art appreciation in art education textbooks designed for art teachers revealed that there are very few theoretical statements about art criticism and evaluation. The inclusion of criteria or standards for evaluating works of art was very brief (Clark and Hurwitz, 1975). Before 1970, only the Feldman text, *Becoming Human Through Art*, presented a method for the criticism and evaluation of works of art. A thorough reading of his theory shows that he believes the student first examines the art object for thematic and utilitarian values prior to description (Feldman, 1982). The student looks for the “pervasive quality,” or style, of the artwork. Immediately the student begins to search for cues to categorize information about the art object. Feldman’s philosophy includes four areas of style: objective accuracy, formal order, emotion and fantasy. The student strongly begins to associate the work with one of the four styles, although these areas of style are not included as portions of Feldman’s model, per se.
The Feldman system of criticism is an inductive process for inferring conclusions (generalities) from the available evidence (particulars). His model of criticism has served as a model in four stages for making statements about a work of art. It has been used by teachers of art appreciation with the underlying premise that students who master this method are able to think and talk intelligently about art. Feldman believes that if students can think and talk intelligently about art they will know and like it better (Feldman, 1982).

Discussing art is considered integral to the critical experience, as well as interpretation of the work of art. Feldman emphasizes the importance of interpretation in explaining the artwork. Feldman states, "Interpretation is tremendously challenging; it is certainly the most important part of the critical enterprise. Explaining a work of art involves discovering its meanings and also stating the relevance of these meanings to our lives and to the human situation in general" (Feldman, 1982, p. 476). He positions this act in step three of his model. The following is Feldman’s method of criticism model for the students to use in art-critical performance:

a) Description

Description is the first step in the process of critiquing art (Feldman, 1994). During the description process critics make observations about what they see. These observations must be objective with no inferences or expressions of personal opinion, listing only what is seen without using value words such as ‘beautiful’ or ‘ugly’. What is the written description on the label or in the program about the work? What is the title and who is (are) the artist(s)? When and where was the work created? Describe the elements of the work (i.e., line movement, light, space). Describe the technical qualities of the work (i.e., tools, materials, instruments). Describe the subject matter. What is it all about? Are there recognizable images? (Jones, 2008)

b) Analysis

Analysis is the second step in art critiquing process (Feldman, 1994). At this point the critics express their thoughts about the message of the artwork. Analysis relies heavily on the critic’s knowledge of the elements of art and principles of design to articulate in knowledgeable style the information seen in a work of art. To describe how the work is organized as a complete composition the critic should ask the following questions: How is the work constructed or planned (i.e., acts, movements, lines)? Identify some of the similarities throughout the work (i.e., repetition of lines, two songs in each act). Identify some of the points of emphasis in the work (i.e., specific scene, figure, movement). If the work has subjects or characters, what are the relationships between or among them?” (Jones, 2008)

c) Interpretation

Interpretation is the third step of the critiquing process (Feldman, 1994). The critics express their opinion about what they think the artist is trying to say by describing what it means to them, how it makes them feel or what expressive qualities the piece has. The critic should ask the following questions: What expressive language would you use to describe the qualities (i.e., tragic, ugly, funny)? Does the work remind you of other things you have experienced (i.e., analogy or metaphor)? How does the work relate to other ideas or events in the world and/or in your other studies? (Jones, 2008)

d) Judgment

Judgment or theory is the final step in the art critique process (Feldman, 1994). During the judgment the critics state their own opinion about the work of art. The artwork assessed whether the piece is a success or failure by asking the following questions: What qualities of the work make you feel it is a success or failure? What criteria can you list to help others judge this work? How original is the work? Why do you feel this work is original or not original? (Jones, 2008)

Studio practice

Studio practice dominates art education practice at the elementary, middle, and high school levels and also in the higher learning institutions. If art education practice is to reflect a concern for teaching for understanding, it is imperative that studio instruction receive attention. A studio practice involves a group of students engaging in art making as if they are artists in a particular field of art (e.g., ceramic artist; urban and regional designer; graphic designer; product designer; media designer). They engage in real world problems-
not exercises, use tools of the artist, and produce art objects. Professionals are models for students. Whatever the student needs to know in terms of technique, use of materials, and problem-solving skills is presented as the student needs it, through small teaching or learning episodes as the unit unfolds. Student artwork is accompanied by artistic statements and displayed as a design process, with preliminary work leading up to the final product.

A number of qualitative studies have been undertaken which investigated some of the complexities of learning and teaching studio practice in higher education, such as the influence of art world beliefs on departmental, instructional, and student beliefs and behaviors (Adler, 1979; Madge and Weinberger, 1973); relationships among student personalities, beliefs, and goals (Strauss, 1970); and how students engage in creative processes (Corno, 1984; Getzels & Csikszentmihalyi, 1976). Other researchers have explored interpersonal interactions and the relationship of an instructor’s philosophy to curriculum and instruction (Dinham, 1987; Janesick, 1982) and the social, philosophical, environmental, and pedagogical dimensions of a ceramics class. With rapid changes taking place in student populations, art world practices, art technologies, and educational institutions, continued research about actual studio classrooms is necessary so that we may understand the nature of studio practice in various contexts.

In practice, the critique in the studio classroom is inextricably linked to the evaluation of art made by student artists. Chapman (1978) also advocates the study and practice of criticism so that children gain the ability to respond to works of art and the environment, becoming familiar with subtle forms of feeling and more challenging images than they are likely to examine by themselves, and learn how experts examine works of art. In learning how experts examine works of art, children need to learn procedures of criticism, and Chapman offers several approaches to criticism including those she refers to as deductive, inductive, and empathic. She details each one of these approaches and stresses the critical procedure of interpretation more than the procedure of evaluation, excluding evaluation totally from the empathic approach.

Through studio practice in relation to art criticism activities in the classroom, students interpret and judge individual works of art. The work of art itself should guide the approach to inquiry. For example, a non-objective painting initially may be approached through description, while a highly-detailed, symbol-filled realistic painting probably would be best approached first through possible interpretations of meaning. Written art criticism can be thought of as persuasive writing, with interpretations of meaning supported by reasoned judgments. Critics’ descriptions are lively. Critics write to be read, and they must capture their readers’ attention and engage their readers’ imaginations. Critics want to persuade their readers to see a work of art as they do. If they are enthused, they try to communicate their enthusiasm through their choice of descriptors and how they put them together in a sentence, a paragraph, and an article (Barret, 1994). Similarly, words are virtually indispensable for communicating a critic’s understanding; words enable us to build bridges between sensory impressions, prior experience, logical inferences, and the tasks of interpretation and explanation (Feldman, 1994).

Art education students may well be more influenced by their participation in studio critiques than by reading about criticism in art education texts or occasionally practicing criticism in art education courses or perhaps even by taking a course in criticism. Studio critiques are likely to be very influential in a student’s education because of the sheer accumulation of critiques students participate in throughout studio courses in several media over several years. Studio practice involving criticism is also likely to be an influential experience because of the students’ acute and vested interest in the critiques since it is their own work which is the subject of critiques. Harmony between studio practice and art education curricula in the practice of art criticism would enhance the chance of success in achieving art education goals for the teaching of art and criticism.

**RESEARCH METHODOLOGY**

The experimental research, the one shot case study discussed follows a standard form: the purpose of an experiment and the rationale for its selection for the proposed study, sample, instrumentation, variables in the study and data analysis and interpretation (Creswell, 2011).
This study utilized a sample comprising 30 (n = 30) students who enrolled as the first year graphic design students. The sample was selected using purposive sampling technique (Fraenkel & Wallen, 2009). The one-shot case study design was used, where this single group of students were exposed to a treatment in order to assess the effect of the treatment. Because the study was still exploratory in nature, the sample was treated as a case, and not as a representation of a population to which the findings can be inferred. As for this study, the methodology was planned to involve two major activities. The two activities were aimed at organizing procedures to gather data.

By the assistance of two lecturers from the university, the researcher managed to complete the tasks of monitoring and collecting students’ artworks with their critical analyses according to the planned procedures. The students’ studio production and critical analyses were assessed by 5 assessors to prevent possible bias in marking student work. This research employed a design that helped to interpret research data by means of quantitative technique. The descriptive statistics made use of frequency counts, percentages and mean scores to determine students’ performances and comparisons of means to determine the differences in contributing factors. The Pearson correlation coefficient was employed to make simple prediction as to what possible dimensions of art criticism may affect students' studio practice scores. The level was set at alpha .05.

**FINDINGS**

The result of students’ overall performance in art critical ability is presented in Table 1.

| Table 1: Scores Achieved by Students in the Art Critical Ability Assessment |
|-----------------------------|-----|-------|----------|---------|
| N                          | Minimum | Maximum | Mean   | Std. Deviation |
| 30                         | 44.00   | 77.00   | 62.267  | 7.830   |

Based on the total score of 100, the mean score of students’ level of knowledge is 62.27. This shows that, by general standards of the university’s score, the students’ acquisition of knowledge in art criticism is good, that is falling within grade B-. Although it is not a superior score, students are generally knowledgeable about art criticism. However, the big range between the highest score of 77 and the lowest score of 44 seems to indicate that the students’ ability is quite varied.

In order to provide a better picture of students’ score, the details of score distribution are presented in Table 2.
Table 2: Grade Percentage Obtained by Students in the Art Critical Ability Assessment

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
</tr>
<tr>
<td>A-</td>
<td>6.7</td>
</tr>
<tr>
<td>B+</td>
<td>13.3</td>
</tr>
<tr>
<td>B</td>
<td>23.3</td>
</tr>
<tr>
<td>B-</td>
<td>20.0</td>
</tr>
<tr>
<td>C+</td>
<td>20.0</td>
</tr>
<tr>
<td>C</td>
<td>13.3</td>
</tr>
<tr>
<td>D</td>
<td>3.3</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2 shows the distribution of students’ scores in their assessment of art criticism. The distribution is observed on the basis of percentage of students’ getting grades from grade A (Superior) to grade F (Inferior). From a total of 30 students, none scored grade A, only 6.7% scored A-. Most students achieved grades B with the highest percentage of 23.3%. While 20% of the students scored B- and C+ respectively and 13.3% scored grade B. The remaining, 3.3% were students with grade D.

Having seen the general students’ performance in their art criticism, it is of interest to examine this performance with respect to the four dimensions, according to Feldman’s Model of Art Criticism, namely: description, analysis, interpretation and judgment. Figure 1 shows the mean score of students’ critical analyses exercise using the bar graphs on dimensions. The total score of each dimension is 20.

Figure 1. Bar chart of the students’ mean score in critical performance with reference to the four critical dimensions of Feldman’s model of art criticism.
As the figure shows, students have demonstrated a fairly equal ability across the four dimensions. However, upon closer scrutiny, the students seemed to have the poorest showing in making judgement with a mean score of 13.73. Meanwhile, their scores on the other two dimensions were: description, Feldman’s highest dimension with a mean score 16.27 and interpretation with a mean score 15.6. Needless to mention, this is the highest dimension to measure critical ability shown in Figure 1. From the findings, it is concluded that students excelled in the area of analysis and description dimensions. On the other hand, students appear to have not developed well in interpretation and judgment dimensions.

Having examined student performance in their critical ability, it is now a question of how good is this showing to indicate connection to their studio practice? The following results are presented to answer this question. Table 3 shows the results of test for correlation using Pearson’s method to determine whether or not such connection exists. The score for studio practice was obtained to correlate with the score of the art critical ability.

Table 3: Results obtained between students’ studio practice and art critical ability scores

<table>
<thead>
<tr>
<th>Studio Practice Score</th>
<th>Art Critical Ability Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>30</td>
<td>65.2</td>
</tr>
</tbody>
</table>

As Table 3 shows, students scored more in studio practice \( M = 65.2, SD = 17.509 \) than critical ability \( M = 62.27, SD = 7.83 \), \( r (28) = .436, p < .05 \). However, it is interesting to note that there appears to be some form of connection between students’ level of critical knowledge and their studio practice. This is evident by the fact that the Pearson’s correlation matrix of \( r (28) = .436, p < .05 \) shows a positive one. What we can believe from the reading this statistic is that students’ good knowledge in criticism would have a good performance in their studio practice and there is a positive linear relationship between the scores at alpha .05.

**CONCLUSION**

This study has attempted to examine students’ ability to connect art critical knowledge to their studio practice. The researcher has drawn several conclusions from the experiences researching art criticism with the students that directed the future research in art education. Art criticism offers students the opportunity to better understand themselves, their culture, and the culture of others thus bringing understanding and enjoyment.

Once the students completed their part of the research study, their work was assessed by five tertiary art educators. The sums of the scores were then used in comparing the students’ written critical analysis based on their given assignment against the four elements of Feldman’s model. At the conclusion of this study, the researcher found that the students only covered two of the four elements to a standard that would have been expected if actually completing Feldman’s model itself. In the area of description and analysis, the students excelled and indeed met the standard of what would be expected if they were given Feldman’s model to complete. Through their artwork, most of the students described what the subject matter of their work meant to them. Some of the students even used art terms to help them describe what they were looking at. Also, most of their interpretations were well thought out, personal, and showed a deep connection to the work of art.

Unfortunately, the other areas of interpretation and judgment were not as well developed. This researcher found that although their critical analysis described certain elements of art, there was no further explanation as to how the artist used these elements and principles of design to further emphasize an idea, theme, or meaning in the work of art. This means that the students are not making the connection between
what they are interpreting the work of art to mean, and what role the artist played in creating the work of art to emulate those interpretations. Finally, the students would only offer a personal judgment of the work of art if they were asked to do so. As a result every student happened to omit such an opinion from his or her written response.

Based on this study, one can conclude that it was not a natural reaction for university students to include their own judgment views without being specifically asked to do so. In conclusion, giving the classroom activity only successfully covered two of the four principles of Feldman’s model; without further prompts from the researcher, the interpretation and judgment areas would not be fully explored.

The activities conducted in the school, college or university have to be consistent such as visiting the art galleries/museums, workshops and talks given by artists/designers. These activities need support from teachers, parents, artists, art critics, curators and the community so that the visual arts can be developed and have a better future. The researcher believes in future research it is important to triangulate data through both quantitative and qualitative means directly through student artwork, student opinions, and experience as an art educator.

Students must have the knowledge in looking at the beauty of art, identifying both local and international artists and appreciating art (expressions and emotions) when viewing a work of art. This research is conducted with the hope that it could offer guidance to school teachers or university lecturers. Teaching art in schools and institutions of higher learning requires teachers and lecturers to have good foundation of understanding of art, so that pedagogically, they can effectively employ different approaches to deliver art to their students. Art criticism should be emphasized in the teaching and learning process of Visual Arts Education.

RECOMMENDATION

Future art teachers should emerge from such a course with a solid theoretical grounding in art criticism and appropriate practical strategies for its implementation in the context of general education. The following recommendations are made to enhance the use of art criticism:

**Art criticism as a compulsory subject in schools and universities**

Looking at the current curriculum taught in the schools, the art criticism subject is not offered in the program. It also happens in tertiary education. This subject is only taught within other topics in the visual arts. By offering the art criticism subject it helps students develop their critical thinking. Developing critical thinking skills and dispositions in young people affords them the means to make thoughtful choices. Aesthetic, critical, and creative inquiry can help facilitate development of these skills and dispositions in art students.

Critical thinking teaches students to raise vital questions and problems, formulate them clearly and precisely; gather and assess relevant information, use abstract ideas to interpret it effectively and come to well-reasoned conclusions and solutions, testing them against relevant criteria and standards; think open-mindedly within alternative systems of thought, recognizing and assessing, as need be, their assumptions, implications, and practical consequences; and communicate effectively with others in figuring out solutions to complex problems.

Creating art encourages students to consider many solutions to resolve artistic problems, and during classroom art critiques they are confronted with divergent points of view from classmates who have solved the same problem in a different way. The Ministry of Education should look into the visual art education curriculum and should introduce art criticism as a new subject apart from art history. Art criticism, with its inherent opportunities to help students create and derive meaning from visual art, is still in need of a firm foundation alongside other areas of the school curriculum. It deserves our attention.

**Combining the use of art criticism as a part of students’ daily sketchbook**

First, for art educators, combining the use of art criticism as a part of students’ daily sketchbook procedures successfully engages students in critical thinking about their art, and impacts their ability to
articulate their ideas in a more meaningful way, improve their journaling performance and develop their ability to think and write critically about their art. Because art teachers are continually describing, analyzing, interpreting, and evaluating works of art during the process of instruction, implementation of the four actions of art criticism into the curriculum proved to be a natural step not only for the students, but for the researcher as an art educator.

By cultivating an atmosphere that encourages artistic risk taking, art teachers can empower their students with the skills to advance to higher cognitive levels. Such exercise has the potential to make art lessons more enjoyable and culturally relevant, and to sharpen students' perceptual skills and heighten their appreciation of the visual world around them. Such a superior power of perception is more conducive to responding appropriately to the visual stimuli around them and appreciating the creative work of others. The systematic introduction of students into the elegance of the world of art criticism would open up many possibilities for better appreciating their environment and the creative work of others.

Art criticism through storytelling

Storytelling can be used as a means of critically looking at a work of art. Storytelling will enable the student to naturally describe, analyze, interpret and judge a work of art without being prompted to do so. In many circumstances, a story will represent an individual's or a group's interpretations of a series of events. A story can be told visually, orally, or through written expression. Storytelling is one of the oldest art forms, and is a classical way to communicate morals, histories and feelings. By using storytelling as the means of communicating art criticism, the students will be able to make an individualized connection to a work of art.

The only conclusion that could be made is that the more opportunities we give our students to express themselves, whether it be verbal, written, or visual, the better. The importance of art criticism in how we view and interpret artworks and the world around us, should lead to further research and inquiry into how to best formulate a critique with the tertiary level background student in mind.

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The Influence of Demographic Factor on Personal Innovativeness Towards Technology Acceptance

Noraini Mohamed Noh[1], Mahizer Hamzah[2], Norazilawati Abdullah[3]

ABSTRACT

Library and Media Teacher (LMT) readiness of accepting and using technology innovation earlier than their colleagues could expedite the technology innovation process into the school education system. The aim of this study was to explore the impact of experience in using computer and the level of ICT knowledge towards personal innovativeness. This study employed a quantitative approach in the form of a survey. A total of 546 LMTs were randomly selected as research samples from Malaysian secondary and primary schools. Data were gathered through a set of instruments adapted from Rogers, using a five-point Likert scale. The construct consist of personal innovativeness and ICT knowledge. Data were analyzed descriptively and inferentially using means, percentage, frequency and multivariate analysis of variance (MANOVA). Findings demonstrated that the majority of the Library and Media Teachers had moderate personal innovativeness. Experience in using computer, level of education and ICT knowledge level are found to influence and contribute to Library and Media Teachers’ personal innovativeness significantly.

Keywords: Personal Innovativeness; Library and Media Teacher; Innovation.

INTRODUCTION

Information and communications technology (ICT) has become a prominent issue of our everyday lives over the past decade. Increasing use of ICT in the teaching and learning environment has changed the teachers’ classical role from teacher-centered educational environment to a student-centered environment. However, teachers are having difficulty accepting the new introduced teaching pedagogical practices because of the personality factor. Recently, there has been a growing interest in using personality as an explanatory tool in the literature to help us understand the usage of IT (Devito Da Cunha & Greathead, 2007; Oreg & Nov, 2008; Pratt & Chudoba, 2006). Personality traits predispose technology users to behave in certain ways under different situations (Thatcher & Perrewé, 2002). The psychology literature used personality as a predictor of human beliefs and behavior. There is substantial evidence for the role of personality traits as predictors of beliefs and behavior across a variety of contexts (Mischel 2004; Pulford & Sohal 2006). According to Schillewaert et al. (2000), personal innovativeness is a characteristic that greatly affects consumer acceptance of technology. Personal innovativeness or general innovativeness, is defined as the “the degree to which an individual is relatively early in adopting an innovation than other members of his (social) system” (Rogers et al., 1971), while personal innovativeness in IT is defined as the willingness of an individual to try out any new information technology (Agarwal & Prasad 1998). High innovativeness level in a person reflects greater readiness in accepting new technology. Level of innovativeness can be influenced by demographical factors too (Roger & Shoemaker 1971).
Background of Study

Web–based learning has become the trend and the state of the art of teaching and learning in this globalization era, networking, k–workers and k-economy. Therefore, in an effort to provide quality education for all through ICT, the Ministry of Education Malaysia has launched a web-based educational portal known as the Educational Web Television or EduwebTV, since March 2008. This video-based interactive educational portal aims at developing the teaching and learning of the nation through creative information and communications technology (ICT). The mission of EduwebTV is in line with the Education Development Master Plan 2006-2010. It is recognized as one of the key efforts by the ministry to enhance the teaching and learning processes in schools regardless of geographical locations (Fong et al. 2010). EduwebTV portal offers eight channels, namely news, academic, documentary, interview, curriculum, interactive, live and guidance. Thus, this innovation brings comfort and an effective learning through the web, which allows teachers and students to access a range of information without the limitations of time and place, as well as Internet facilities available in schools. With this development, the teachers need to be more open and willing to accept updates of educational technology introduced in schools. Therefore, teachers should be aware of the presence of any innovation implemented in schools, and know the importance of using technology for teaching and learning in the classroom (Littrell et al., 2005).

In the context of the dissemination of EduwebTV innovation in schools, Library and Media Teachers (LMT) play an important and significant role as a catalyst to other users towards the acceptance of using new technology in teaching and learning (Harada & Hughes, 2007). To ensure the successful diffusion of EduwebTV in school, LMT should be the model where they need to become a leading consumer of EduwebTV in teaching and learning, a consultant to other teachers on EduwebTV and able to convince the other teachers on the convenience and usefulness of EduwebTV. In other words, the LMT need to be more innovative and confident to face the variety of educational innovations introduced as an effort to promote, persuade and convince other teachers in school. LMT also needs to be the early adopter of innovation compared to other teachers in their schools. Therefore, LMT must have high personal innovativeness and personal innovativeness in IT. In this study, personal innovativeness refers to the willingness of LMT to receive any innovation implemented in school voluntarily without any force, while personal innovativeness in IT is defined as the willingness of an individual to try out EduwebTV as a domain specific innovation.

Many factors have been pointed out as barriers for teachers in adopting new technology. Factors such as knowledge, skills, attitude, perception, beliefs and commitment (Dusick, 1998), gender, age and experience in using ICT (Wong, 2002), access to computer, ICT training experience and support (Norizan, 2003) are frequently cited and associated with barriers to successful ICT integration in schools. According to the British Educational Communications and Technology Agency (BECTA 2004) the hindering factors that affect teachers include confidence level in using technology, access to facilities, courses and training attended that lacked focus on pedagogical skills and teachers’ reluctance to change teaching practice. Research has shown that teachers who have more years of computer experience have positive attitudes towards computers (Rozell & Gardner, 1999; Shashaani, 1997). Education level and mobility are positively related to innovativeness because they broaden people’s outlook and render them more open to new ideas, ways of living, and products (Tellis et al., 2009). Previous research has shown that prior experience with related products can be a determinant for consumers’ early adoption of an innovation (Gatignon & Robertson, 1991). Specifically in the area of information technology, numerous studies have shown that previous experience in using computer will influence the degree of technology acceptance (Jiang et al., 2000; Thompson et al., 1994; Venkatesh, 2000). Based on past studies, experience using computers, exposure as well as education level will influence the level of individual innovativeness in accepting new technologies. Therefore, this study will try to answer whether the present LMT has high level of personal innovativeness on the acceptance of EduwebTV. Is personal innovativeness a constant of trait or can it be influence by the social system?
METHODOLOGY

Research Design

EduwebTV is a new innovation currently implemented in Malaysian schools as one of the alternatives for Teaching and Learning. For the purpose of diffusion at schools, Ministry of Education (MoE) has appointed LMT teachers to further enhance and quicken the acceptance of EduwebTV. Currently, there is no research on LMT and EduwebTV being conducted; thus this study is important to assess their level of personal innovativeness towards new innovation and the factors that influence them. This study employed quantitative research methodology in the form of survey, using a set of questionnaires posted to selected schools in Malaysia. The method was chosen because the sample is widely spread around the schools in Malaysia.

Population and Sampling

The target population for this study are LMT serving in government secondary and primary schools in Malaysia. The population of the Library and Media Teachers from four different states were randomly selected based on four zones (N = 2456). The sample was selected using a systematic random sampling technique because this technique is effective to obtain the information from each of the states (Sekaran, 2000). The information is related to the usage, acceptance and perception toward usability of EduwebTV. This technique was used to ensure that each state has enough representatives to be the studied. Besides, it can control the internal validity of the sample. In this study, a total numbers of 546 LMT been selected to ensure sufficient data for analysis, including those who are graduates and non-graduates.

Instrumentation

A set of instrument was employed for data collection. The instrument consisted of personal innovativeness questionnaire, personal innovativeness in information technology questionnaire and ICT Knowledge questionnaire. The personal innovativeness questionnaire consisted of 20 items related to openness, enthusiasm and reluctance. The personal innovativeness information technology questionnaire consisted of 6 items. The ICT Knowledge questionnaire consisted of 28 items related to knowledge of basic ICT, the knowledge of application ICT and the knowledge of integrated ICT. All the questionnaires were self-report form with the Likert scale ranging 1 to 5 (strongly disagree to strongly agree). Based on pilot testing conducted on 250 teachers, the instrument reliability was as follows: .829 (personal innovativeness), .833 (personal innovativeness information technology) and .947 (ICT Knowledge).

To examine construct validity of measures adopted in this study, a factor analysis was performed. Principal factor analysis with varimax rotation was conducted to assess the underlying structure for the 20 items of the personal innovativeness questionnaire. After rotation, three constructs appeared. Based on the fact, the items were namely: openness, enthusiasm and reluctance (Table 3). The first factor accounted for 25.71% of the variance, the second factor accounted for 15.15% and the third factor accounted for 7.88%. For openness, enthusiasm and reluctance, the total variance explained was 48.8%.
Table 3: Factor Analysis for personal innovativeness

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI6</td>
<td>.749</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI 13</td>
<td>.743</td>
<td></td>
<td></td>
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<tr>
<td>PI 7</td>
<td>.742</td>
<td></td>
<td></td>
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<tr>
<td>PI 17</td>
<td>.719</td>
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<td></td>
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<tr>
<td>PI 14</td>
<td>.690</td>
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<tr>
<td>PI 10</td>
<td>.689</td>
<td></td>
<td></td>
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<tr>
<td>PI 20</td>
<td>.665</td>
<td></td>
<td></td>
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<tr>
<td>PI 4</td>
<td>.453</td>
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<td></td>
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<td>PI 19</td>
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<td>PI 16</td>
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<td>PI 18</td>
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<td>PI 15</td>
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<td>PI 3</td>
<td>.507</td>
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<tr>
<td>PU 1</td>
<td></td>
<td>.733</td>
<td></td>
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<tr>
<td>PI 9</td>
<td></td>
<td>.705</td>
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<tr>
<td>PI 12</td>
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<td>.622</td>
<td></td>
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<tr>
<td>PI 11</td>
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<td>.619</td>
<td></td>
</tr>
<tr>
<td>PI 8</td>
<td></td>
<td>.585</td>
<td></td>
</tr>
<tr>
<td>PI 2</td>
<td></td>
<td>.479</td>
<td></td>
</tr>
</tbody>
</table>

Factor 1 = reluctance; Factor 2 = openness; Factor 3 = enthusiasm

Principal factor analysis with varimax rotation also was conducted to assess the underlying structure for the 6 items of the personal innovativeness information technology. After rotation, a construct appears. For personal innovativeness information technology, the total variance explained was 71.95 %.

Table 4: Factor Analysis for personal innovativeness information technology.

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIIT 21</td>
<td>.814</td>
</tr>
<tr>
<td>PIIT 22</td>
<td>.830</td>
</tr>
<tr>
<td>PIIT 23</td>
<td>.909</td>
</tr>
<tr>
<td>PIIT 24</td>
<td>.837</td>
</tr>
<tr>
<td>PIIT 25</td>
<td>.622</td>
</tr>
<tr>
<td>PIIT 26</td>
<td>.619</td>
</tr>
</tbody>
</table>

Data Analysis

Data were analyzed using SPSS v. 12.5 descriptively and inferentially using mean, standard deviation, frequency, percentage, and multivariate analysis (MANOVA). Besides assessing the factors items, mean and standard deviation for the items were validated. All means scores were > 2.5 of the midpoint, ranging from 2.5 to 3.1. This indicated an overall positive response to the scales in the study. Multivariate normality can be assessed through the inspection of univariate distribution index values, with univariate skew indexes greater than 3.0 and kurtosis indexes greater than 10 indicative of unacceptable non-normality (Kline, 2005). Skew and kurtosis indices for all scales were acceptable. It means the data was normal distributed and can be used for the MANOVA analysis.
FINDINGS

The majority of the LMTs were female (n = 436, 78.6%) while another 110 were male (21.4%). In terms of education level, a total of 286 LMTs (52.4%) are graduates and 260 LMTs (47.6%) are non-graduate. A total of 103 LMTs (52.5%) had low level of ICT knowledge, another 259 LMTs (47.4%) had moderate, while 184 LMTs (33.7%) had high level of ICT knowledge. As for their experience in using computers, many of the LMT (n = 320, 42.1%) had experience between 5 to 10 years, 210 LMTs (36.8%) had more than 10 years, while 115 LMTs (21.1%) had less than 5 years of experience in using computers.

For the level of personal innovativeness among the LMTs, this finding shows that the level of personal innovativeness among LMT is moderate and the mean score was 3.38 (SD = 0.38). Only 0.8% LMTs (n = 4) had low level of personal innovativeness. Majority of the LMTs (n = 428, 78.4%) had moderate, while another 20.8% LMTs (n = 114) demonstrated a very high level of personal innovativeness.

The level of personal innovativeness in information technology (PIIT) among the LMTs in this finding is moderate and the mean score was 3.27 (SD = 0.58). Only 0.8% of LMTs (n = 13) demonstrated low level of PIIT. This means that curiosity did not motivate LMTs to learn and accept EduwebTV. Majority of the LMTs (n = 330, 60.5%), had moderate level while another 30.2% LMTs (n = 116) had very high PIIT.

Multivariate variance analysis (MANOVA) was able to establish that ICT knowledge level (Wilks’ value (λ) = 0.737, F[4, 1087] = 44.404, p < .05), education level (Wilks’ value (λ) = 0.945, F[2, 539] = 15.562, p < 0.05) and experience in using computer (Wilks’ value (λ) = 0.941, F[4, 1804] = 8.399, p < .05) contributed to the difference mean for LMTs’ acceptance readiness of EduwebTV in term of personal innovativeness and personal innovativeness in information technology.

The ANOVA analysis results showed significant differences mean score in the levels of alpha using Bonferroni correction (0.05 / 2 = 0.025) for the two dependent variables (personal Innovativeness and personal innovativeness in information technology) based on ICT knowledge level, experience in using computer and education level. LMTs with high ICT knowledge level had the highest mean scores (PI = 3.63, PIIT = 3.79) in the personal Innovativeness and personal innovativeness in information technology compared to with low ICT knowledge level (PI = 3.44, PIIT = 3.16). LMTs with high education level had the highest mean scores (PI = 3.81, PIIT = 3.68) in the personal Innovativeness and personal innovativeness information technology compared to those with low education (PI = 3.42, PIIT = 3.48). LMTs with more than 10 years’ experience in using computer had the highest mean scores (PI = 3.58, PIIT = 3.35) in the personal Innovativeness and personal innovativeness information technology compared to those with less than 5 years’ experience in using computer (PI = 3.35, PIIT = 3.08).

Further analysis found that there was a significant interaction effect between education and ICT knowledge level (Wilks’ value (λ) = 0.959, F[4, 1087] = 5.755, p < .05) on LMTs personal innovativeness (F[2, 540] = 5.312, p < 0.025) and personal innovativeness information technology (F[2,540] = 7.010, p < 0.025). LMT who had high ICT knowledge level and high education level had the highest mean scores in the Personal Innovativeness and personal innovativeness information technology compared to those who have high ICT knowledge level but low education level.

DISCUSSION & RECOMMENDATION

LMTs graduates had high level of personal innovativeness and personal innovativeness information technology compare to non-graduates LMTs. This is due to the exposure in using the latest technologies while studying in higher institutions among the graduate LMTs. Based on this study, the demographics of the LMT graduates seem to have their own higher initiatives (62.5%) to attend ICT courses without administrative direction compared to non-graduate LMTs. This finding is consistent with the Lin (2006), LaBay and Kinnear (1981), and Hasrul Nizam (2006) findings, that the higher education level makes for higher willingness of acceptance to innovation. The findings also showed that LMTs with higher ICT knowledge have high level of personal innovativeness, compared to LMTs with low ICT knowledge level. This is because they have the basics of ICT and the integration of ICT in teaching and learning, thus making it easier to understand and
apply new technology in classrooms. Fadilah and Balakrishnan (2010), Mahmet Akif and Omur (2008) also obtained similar findings that teachers with higher computer literacy level have more willingness to use computers in their teaching compared to teachers with low computer literacy.

An interaction was seen between education level and the ICT knowledge level in the willingness to accept EduwebTV among LMTs. It means that LMT who had high educational level, and often engage in technology use are more committed to the technology programs in schools. The findings also showed that LMTs with more experience in using computers are more willing to adopt new technology. Based on the experience, they can use existing skills to adjust with the use of EduwebTV. These findings are consistent with the findings of Jiang et al. (2000), Thompson et al. (1994) and Venkatesh (2000) that previous experience in using computers will influence the degree of technology acceptance.

Therefore, demographic characteristics are likely to increase or decrease the level of personal innovativeness and personal innovativeness in information technology. Users with high education and knowledgeable in ICT are more receptive to accepting the new technology. It shows that innovativeness is not a constant genetic characteristic but it can be influenced by the social system and can be continuously improved. This finding is consistent with studies of Chang et al. (2005), Vrechopoulos et al. (2001) and Rosen (2008) who found that the level of consumer innovativeness is influenced by user demographic characteristics.

CONCLUSION AND RECOMMENDATION

Based on the studies, it can be concluded that LMT should be aware of a product to promote in advance. In another words, they should be ready and confident to be in the category of “early adopters”. LMT need to be early users of EduwebTV compared to other teachers in the school and as individuals referred to concerning the EduwebTV innovation. LMT should be able to serve as a catalyst in implementing innovative programs especially related to the use of media and technology in teaching and learning. As stated, the higher education level with higher ICT level and computer experience is associated with higher innovativeness, which is affecting the role of LMTs as technology development agents in school. Hence, to appoint Library and Media Teachers, the candidates must be selected based upon their level of education, level of ICT knowledge and ICT skills besides having attended specific training in school library management. One of the limitations of this research is that it only used questionnaire and not interview because of time constraints. The survey was also conducted only in peninsular Malaysia, excluding Sabah and Sarawak. Hence, further research should consider investigating the usage of EduwebTV in the classroom using qualitative research and expanding the sample to include LMTs in Sabah and Sarawak.

REFERENCES


