The Implementation of Instructional Innovations and Assistive Technologies in Emerging Developing Countries within the Asia-Pacific Region

Mas Nida MD KHAMBARI\textsuperscript{a} & Niwat SRISAWASDI\textsuperscript{b}

\textsuperscript{a\textsuperscript{b}Organizers of WICTTEE 2017}

\textsuperscript{a}Faculty of Educational Studies, Universiti Putra Malaysia, Malaysia

\textsuperscript{b}Faculty of Education, Khon Kaen University, Thailand

*khamasnida@upm.edu.my

Most of the emerging developing countries within the Asia-Pacific region are actively elevating their education system to greater heights. Technologies are considered as instrumental in fostering effective and inclusive learning environment and moving pedagogical stance towards a learner-centered instruction (UNESCO, 2016). Instructional innovations and assistive technologies are high on the agenda in emerging developing countries within the Asia Pacific region. Harnessing ICT in learning institutions are one of the aspirations outlined in Education 2030 as a means to strengthen the education system, knowledge dissemination, and information access, and quality and effective learning (UNESCO, 2017).

In response to the growing research diversity among emerging developing nations within the Asia-Pacific region, the Sixth International Workshop on ICT Trends in Emerging Economies (WICTTEE 2017) is held in conjunction with the 25\textsuperscript{th} International Conference on Computers in Education, Christchurch, New Zealand. WICTTEE 2017 is organized by the SIG on Development of Information and Communication Technology in the Asia Pacific Neighbourhood—DICTAP. The visions of DICTAP are to:

- Share ideas and best implementation practices related to government policies and incentives aimed at promoting human resource development, technology transfer, effective e-learning strategies and implementation, software and content development suitable for each member of the Asia-Pacific neighborhood;
- Coordinate and promote community-based e-learning activities, global sharing and management of information and knowledge. Examples of such communities are the Asia-Pacific Society on Computers in Education (APSCE) and the Association of South East Asian Nations (ASEAN); and
- Coordinate and promote student and staff exchange among Asia-Pacific neighborhood member nations to promote more effective sharing of knowledge and practices.

The missions of DICTAP are to:

1. Connect researchers from emerging developing countries within the Asia-Pacific region to share scholarly findings and professional insights in ICT development in the field of education;
2. Establish networking opportunities among researchers, reduce the research gap between the researchers from more developed and less developed countries; and
3. Foster, enhance and sustain collaborations among these researchers.
WICTTEE 2017 is the sixth workshop that we are organizing in the hope to realize the aforementioned visions and missions. The workshop is a continuation of our relentless effort to provide a dynamic platform for practitioners and researchers alike to come together to share their country experiences.

We are extremely pleased that practitioners and scholars with university affiliations from Malaysia, Thailand, Indonesia, Nigeria and India will be congregating in Christchurch, New Zealand to present their research findings and share their views at WICTTEE 2017. A total of ten papers will be presented in a half day workshop.

We would like to take this opportunity to thank all the authors who submitted their papers to WICTTEE 2017. We would like to record our sincerest appreciation to our Program Committee Members who dedicated their time and expertise to the most challenging and demanding task of reviewing the paper submissions. Last but not least, we would like to thank DICTAP’s Advisory Committee Members for their wisdom and guidance in making WICTTEE 2017 a reality.

References


The Effect of Think-Pair-Share Cooperative Learning Model Assisted With ICT on Mathematical Problem Solving Ability among Junior High School Students

Khoerul UMAM*, SUSWANDARI, Nur ASIAH, Indri Trisno WIBOWO & Syaiful ROHIM

University of Muhammadiyah Prof DR HAMKA, Indonesia

khoerul.umam@uhamka.ac.id

Abstract: The main purpose of this research examines the effectiveness on how mathematics teachers have begun to Integrate Information and Communication Technology (ICT) with Think Pair Share Cooperative Learning Model to improve students’ mathematical problem solving ability in junior high school classroom practice. This study was experimental research with a quasi-experimental design. The samples of the study are 36 students for classroom experiments and 36 students for classroom control. The instruments employed in this study were pre-test and post-test. The instruments are made in essays forms which design to measure students’ mathematical problem solving ability. The data were analyzed by using descriptive and inferential statistics. Our finding has shown us that (1) Think Pair Share Cooperative Learning model assisted with ICT had a positive impact on student’s mathematical problem solving ability; (2) there is a statistically significant mean difference in students' mathematical problem solving ability between experiment class and control class.

Keyword: Think Pair Share Cooperative Learning, Mathematical Problem Solving Ability.

1. Introduction

Mathematics learning is not only oriented toward students’ mathematics learning outcomes, but it needs to accommodate the various abilities that must be possessed by students in the mathematical learning process. One of the abilities developed in the learning of mathematics is a mathematical problem solving ability. This ability can assist students in solving many complicated or simple mathematical problems. The research findings facts in Jakarta schools show that students' mathematical problem solving skills are still not satisfactory (Septiany, Purwanto & Umam, 2015; Slamet & Samsul, 2014). To improve student’s mathematical problem solving ability, we need to enrich our learning process by using various media such as ICT. According to Alim, Umam, & Rohim (2015), teaching and learning process which is used ICT will improve learning quality. Improving learning quality will encourage students to more engaged and enjoyable in learning process (Alim, Umam & Wijirahayu, 2016). One of the learning models that can be used to improve learning quality and students' mathematical problem solving ability is Cooperative Learning Model.

In applying cooperative learning model, the researchers chose Think-Pair-Share Cooperative Learning Model because it offers a learning process to more challenging activity which is started by involving students to think about a problem given by a teacher. Lie (2005) believes that pair exchange techniques give students more opportunities to engage themselves and work collaboratively with other students. Furthermore, students are also created in pairs so that students can discuss the information presented from the problems given by the teacher and then share with the whole class they have been talking about. Wena (2009) said that cooperative learning seeks to use peers as a resource for learning. Think-Pair-Share cooperative learning model steps that begin with thinking, pairing and sharing which is integrated with ICT media are designed to improve students' mathematical problem solving skills.
2. **Literatures**

2.1. **Think Pair Share Cooperative Learning Model assisted with ICT**

According to Wena (2009), Cooperative Learning is a learning system that seeks to use peers (other students) as a source of learning in addition to teachers and other learning resources. Cooperative learning is a learning approach that focuses on the use of small groups of students to work together in maximizing learning conditions to achieve learning objectives (Junaedi, 2008).

Think-Pair-Share Cooperative Learning Model is a cooperative learning model first developed by Frank Lyman of the University of Maryland in 1985 (Rahmatun, 2014). Learning model is oriented to students, students are asked to process the problems presented by the teacher. Lie (2005) believes that pair exchange techniques give students the opportunity to engage themselves and work with others.

Think-Pair-Share cooperative learning model gives students more opportunities to think for themselves, to discuss, to help each other in groups, and to be given opportunities to share with other students.

In Think-Pair-Share Cooperative Learning Model there are 3 steps, namely thinking, pairing and sharing. According to Trianto "Master uses the following steps: (1) thinking; (2) in pairs; (3) share (Trinoto, 2009). The first stage is thinking, at this stage the teacher asks a question or problem associated with the lesson using ICT, and ask students to use a few minutes to think for themselves. The second stage is pairing, at which point the teacher asks the students to pair up and discuss what they have gained. The third stage is sharing, at this stage the teacher asks the pairs of students to share their work using ICT with whole class and other students give feedback from their friend's performance. The stages in Think-Pair-Share Cooperative Learning Model techniques are:

1. Thinking, the teacher asks questions and gives the opportunity to think before the students answer the proposed submission.
2. In pairs, the teacher asks students to answer the problem.
3. Sharing, teachers ask pair of students to present their work in front of class while other students give feedbacks for their friends’ performances (Trianto, 2009)

2.2. **Student’s Mathematical Problem Solving Abilities**

Mathematical problems ability is the ability to find a way to solve mathematical problems by using the relationship between mathematical conceptual and logics (Schoenfeld, 2014). The ability to solve mathematical problems is an attempt to translate mathematics that includes the ability to apply mathematical ideas to the context of problems and the ability to work together to develop and solve problems. Thus, the ability to solve mathematical problems is the ability of students in finding solutions to mathematical problems in accordance with the ability to think logically by applying mathematical ideas in solving problems. In solving the problems, each individual needs a different time based on their mathematical knowledge and skills. According to Siswono (2008), there are several factors that affect the problem-solving ability, namely:

1. Initial experience. Experience on tasks to solve the story or application problem. Early experiences such as fear (phobia) towards mathematics can hinder students' ability to solve problems.
2. Mathematical background. Students' ability to varying degrees of mathematical concepts can lead to differences in students' ability to solve problems.
3. Desire and motivation. Strong internal impulses, such as cultivating my "CAN" and external beliefs, such as being given interesting, challenging, contextual problems can affect the outcome of problem solving.
4. Problem Structure. The structure of the problem given to the students (problem solving), such as verbal or image formats, complexity (degree of difficulty), context (story or theme background), language problems, or problem patterns.
Siswono (2008) also mentioned that in solving the problem necessary skills that must be possessed, namely: (1) empirical skills (calculation, measurement); (2) applicative skills to deal with common situations (setting occurs); (3) thinking skills to work on an unfamiliar situation.

3. Methods

This research is a quantitative research with quasi experimental design. This research was conducted in two classes which has the same characteristics. Firstly, an experimental class which is taught by using Think Pair Share Cooperative Learning Model assisted with ICT, whereas a control class which is taught by using conventional learning. Population in this study are all students of class VII which is approximately about 72 students Junior High School consisted of 36 students in experiment class and 36 students in control class. The instruments are made in essays forms which design to measure students’ mathematical problem solving ability. Problem solving instruments was developed through a series of daily life around students environments and instructed students to think carefully in applying an appropriate mathematical concept for given problems.

In the experimental class, the teacher sets the classroom for students to sit in groups. The teacher presents open-ended mathematics problems with the help of ICT media, then the students are asked to think about solving the problem. In groups, students begin to think about choosing relevant information and appropriate mathematical concepts to solve the problem. Once students are grouped to solve a given problem, each group is asked to present the outcome of the problem given with the help of ICT media while other students will give feedbacks for their friends’ performances.

While in the control class, teachers do not design student seats in groups. The teacher explains the mathematical material directly with lecture method and teacher-oriented learning tendency so that the student only as the listener.

4. Results

4.1. Student Mathematical Problem Solving Abilities

The statistical description show that problem solving ability in experiment class by using Think Pair Share Cooperative Learning assisted with ICT as follows:

<table>
<thead>
<tr>
<th>Mathematical Problem Solving Ability</th>
<th>Achievement Indicators</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students ability to understand the problem</td>
<td>≥ 75 %</td>
<td>14 students 47 %</td>
<td>25 students 83 %</td>
</tr>
<tr>
<td>Students ability to design the plan for solving the problem</td>
<td>≥ 60 %</td>
<td>10 students 33 %</td>
<td>20 students 67 %</td>
</tr>
<tr>
<td>Students ability to solve the problem</td>
<td>≥ 50 %</td>
<td>8 students 27 %</td>
<td>14 students 47 %</td>
</tr>
<tr>
<td>Students ability to look back on solution</td>
<td>≥ 30 %</td>
<td>5 students 17 %</td>
<td>10 students 33 %</td>
</tr>
</tbody>
</table>

From table 4.1 shows that students' mathematical problem solving ability in experimental class is improved. The most significant student ability was seen in students' ability to understand the problems of 14 students (47%) to 25 students (83%). Problems presented with the help of ICT and learning materials using ICT can improve students' mathematical problem solving ability.

The data of statistical description show that the problem solving ability in the control class is as follows:
### Table 4.2 Students Mathematical Problem Solving Ability for Control Class

<table>
<thead>
<tr>
<th>Mathematical Problem Solving Ability</th>
<th>Achievement Indicators</th>
<th>Student Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-test</td>
<td>Post-test</td>
</tr>
<tr>
<td>Students ability to understand the problem</td>
<td>≥ 75 %</td>
<td>14 students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47 %</td>
</tr>
<tr>
<td>Students ability to design the plan for solving the problem</td>
<td>≥ 60 %</td>
<td>10 students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33 %</td>
</tr>
<tr>
<td>Students ability to solve the problem</td>
<td>≥ 50 %</td>
<td>6 students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 %</td>
</tr>
<tr>
<td>Students ability to look back on solution</td>
<td>≥ 30 %</td>
<td>3 students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 %</td>
</tr>
</tbody>
</table>

#### 4.2. T-test Results

To find evidence of a significant difference between experiment and control class, we use T-test. Based on T-test performance, we can see the result as follows:

**Table 4.3 Results of T-test for Students' Mathematical Problem Solving Ability between Experiment and Control Class**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>T-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Class</td>
<td>3</td>
<td>14,910</td>
<td>4,523</td>
<td>*</td>
</tr>
<tr>
<td>Control Class</td>
<td>3</td>
<td>12,032</td>
<td>4,102</td>
<td>*</td>
</tr>
</tbody>
</table>

*p > 0.05

The T-test results show that there is a statistically significant mean difference in Students' Mathematical Problem Solving Ability between experiment class and control class. It appears that students in an experiment class perceived that Think-Pair-Share Cooperative learning using ICT was very helpful to improve their mathematical problem solving ability.

### 5. Conclusion

The results have shown that the low ability of problem solving mathematical students caused by some factors that affect problem solving ability which is rarely not built in class. By using Think-Pair-Share cooperative learning model integrated with ICT can be concluded that there is an improvement of students' mathematical problem solving abilities. Especially in experimental class, students are able to solve problems with creative solutions. The result of this research can be concluded that Think Pair Share Cooperative Learning model assisted with ICT had a positive impact on student’s mathematical problem solving ability. Data also have given us that there is a statistically significant mean difference in students' mathematical problem solving ability between experiment and control class.

### Acknowledgements

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References


A PBL-based Professional Development Framework to Incorporating Vocational Teachers in Thailand: Perceptions and Guidelines from Training Workshop

Sasithorn CHOOKAEW*, Charoenchai WONGWATKITb & Supachai HOWIMANPORNc

a,cDepartment of Teacher Training in Mechanical Engineering, Faculty of Technical Education, King Mongkut’s University of Technology North Bangkok, Thailand
bIndependent Researcher, Bangkok 10160, Thailand
*sasithorn.c@fte.kmutnb.ac.th

Abstract: Vocational education and training have become significant in developing the country in various aspects. Thailand has emphasized on improving the quality of vocational education with the promotion of ICT to support the teaching and learning. However, vocational teachers are limited with the knowledge, skills, and confidence in using technology in their classroom, making their students’ learning unmotivated and unengaged to the learning. Therefore, this study proposes a novel framework to developing the vocational teaching with the use of ICT support. The framework aims to make the vocational teachers skillful with TPACK in serving 21st-century education. Thus, this framework is integrated into the training workshop basing on project-based learning strategy, starting from considering actual teaching context, planning and finding solutions to address the need-to-be-enhanced learning topics in particular situations, applying learning technologies to support and motivate teaching and learning, to creating instructional activities. Furthermore, an experiment to investigate the perceptions and feedbacks towards the proposed framework was conducted with the vocational teachers in a training workshop. The findings show that the framework could help increase the vocational teachers’ perceptions on using ICT for teaching on confidence in using ICT for teaching and ease of use the ICT to assist teaching. Moreover, the teachers provide qualitative perspective in using ICT and suggestions for the institution. In addition, a proposal of practical guidelines and suggestions on vocational teachers’ development in Thailand with ICT has been proposed.

Keywords: Technology-enhanced vocational learning, vocational education and training workshop, TPACK

1. Introduction

Information and communication technology (ICT) skills are essential for effective participation in today’s world. Thailand’s ICT education policies and explores some of the reason why despite significant investment. While OECD/UNESCO (2016) identified one of policy issues that may be holding Thailand that is teachers’ confidence and capacity to use ICT in the classroom. The teachers have limited confidence in using technology to facilitate specific concepts or skills and to support creativity (Kafyulilo & Keengwe, 2014).

Moreover, Thai formal education system has included general education and vocational education to help move the country beyond; especially, Thailand government has focused on enhancing the vocational education. Presently, several countries have seen a significant return of interest in vocational education and training (VET) and an increasing policy focuses on qualification completions in VET education (McGrath, 2012; Van, Ritzen & Pieters, 2014; Fieger, 2015). Vocational education and training (VET) focus on specific practical skills which allow individuals to
engage in a specific professional activity (Agrawal, 2013). One of the mechanisms for enhancing the standard of VET is education system especially, the teachers in vocational education. Vocational teachers’ work is based on teaching competence and competence related to a specific work-life vocational practice (Andersson & Köpsén, 2015). Previous research presented the teachers’ competencies for teaching and learning process to support the learner achievement (Fritsch, et al., 2015). In addition, some studies reported that the teachers’ beliefs that influence their behavior in the classroom could be improved student engagement in vocational education (Van, Ritzen & Pieters, 2014).

Vocational Education and Training (VET) in Thailand are offered at the secondary level in specific schools or institutions, or in a dual model based on agreements between schools and companies. After two years of coursework, students obtain a diploma, and they may continue to higher VET at tertiary institutions. Therefore, vocational teacher training plays a major role in the development of knowledge and skill of vocational teachers in Thailand vocational colleges. Thailand has numerous vocational teachers and various branches such as Home Economics, Fashion Design, Mechanic, Electronic, etc. However, the barriers to professional development are to employ technology and adapt for teaching that limits the impact of vocational competency. Therefore, if the confidence of using technology for vocational teachers has been improved, it could finally enhance the vocational competency and teaching performance.

Based on this perspective and the limited use of ICT in vocational teaching in Thailand, therefore, this study proposed a framework for vocational teachers’ professional development in Thailand, hereinafter called TVET. In this framework, ICT and learning technologies play a crucial role to promote the teachers to have adequate teaching skills for 21st-century education based on Technological- Pedagogical- Content Knowledge (TPACK) strategy. Meanwhile, Project-Based Learning (PBL) strategy was used to develop meaningful instructional activities with the experience of technology and tools. Furthermore, the experiment was conducted with vocational teachers from various domains in a training workshop to seeking for the answers towards the following research questions:

1) Do the vocational teachers reveal higher perceptions on using ICT to support teaching with the TVET framework?
2) What are their feedbacks and suggestions on the proposed TVET framework?

This research study not only made an attempt to enhance the vocational teaching’s quality in Thailand with the proposed framework, but also presented the guidelines and suggestions on vocational teachers’ development in Thailand with ICT.

1. Related Studies

1.1. PBL in Professional Development

Project-Based Learning (PBL) is considered as a potential constructivist teaching and learning framework. The teachers need a wide range of supports to implement this strategy in their classrooms successfully. Moreover, PBL is presented as a way to think about innovative instruction by providing a possible means of enactment (Marx, et al., 1994). Previous research presented the continuous professional development model, to support teachers to enact Project-Based Learning in Science and Technology that engage in PBL develop skills of independent learning and learn to be more open minded, remember what they learn longer (Fallik, Eylon & Rosenfeld, 2008).

In this study, we applied the five steps of Project-Based Learning (PBL) by Krajcik & Blumenfeld (2006) in learning processes consisting of: (1) Start with diving a question (2) Explore the diving question in via planning (3) Find solution via research the information for design investigations (4) Learn to use technology for constructing products and (5) Share ideas via presentation process.

1.2. TPACK and Vocational Teaching

Mishra, & Koehler, (2006) presented Technological Pedagogical Content Knowledge (TPACK) framework that attempts to capture some of the essential qualities of knowledge required by teachers
for technology integration in their teaching while addressing the complex, multifaceted and situated nature of teacher knowledge. Therefore, teachers need a specialized form of professional knowledge termed as technological pedagogical content knowledge (TPACK) to support ICT integration for 21st-century learning (Koh, Chai & Lim, 2016). At the heart of the TPACK framework, is the complex interplay of three primary forms of knowledge consisting of Content (CK), Pedagogy (PK), and Technology (TK). Several research studies proposed the Technological Pedagogical Content Knowledge (TPACK) framework to use the conceptual tool in studies that consider technology integration into classrooms (Olofson, Swallow & Neumann, 2016). In addition, several studies investigated to develop teachers who have the TPACK capabilities to use technologies to support teaching and learning (Kadijevich, 2012; Srisawasdi, N, 2014; Finger, et al., 2015; Yeh, et al., 2015; Tai, Pan & Lee, 2015). Khan, Bibi, & Hasan, (2016) proposed teachers' conceptions of technology integration teaching that have flexible teaching of the most significant conceptions of teaching within the context of vocational education. Therefore, vocational teachers need to acquire a technology to transfer the knowledge through pedagogies effectively.

2. TVET Development

In this study, we attempted to design an framework to support the professional development of vocational teachers, hereinafter called TVET. The goal of this framework is to help prepare the vocational teachers equipped with the TPACK strategy and ready for the 21st-century education.

As shown in Figure 1, the TVET framework runs in the training workshop and implementation with certain steps, in the meantime, the vocational teachers (trainees) are gaining the knowledge of TPACK with following strategies, including active learning, formative assessment, engaging learning environment, and learning motivation. The workshop training process runs in following steps.

![Figure 1. Overall Structure of the TVET Framework](image)

1. The trainees firstly get introduced to ICT and learning technology tools, followed by the hands-on experience to their advantages and functionalities. This process enables the trainees to have an impression and engagement with such ICT tools to be implemented in their teaching topic.

2. Then, the trainees are told to create a plan and develop their instructional activities following the PBL process by adopting the learned ICT tools. To perform this important process effectively, the trainees are encouraged to work in this sequence:

   - 1. For actual implementation in the classroom
   - 2. Be prototype for exchanging with other subjects and institutions
   - 3. Get handfull data for academic writing
• Diving a question: this helps the trainees to establish the topic needed to scaffold or to enhance as it may frequently find difficulties, misconception, low motivation, low participation/involvement by their students. At this point, the project has already been initiated.
• Planning: this step would create an operation plan to achieve the need-to-solve problems by considering their capacity, institutional infrastructure and facilitation, classroom environment, and availability of the computer/mobile devices. At this point, a plan is visualized.
• Find the solution: in considering the plan and actual environment, the trainees search and study for the possible solutions, e.g. using mobile devices in a group activity, using social media for the discussion and reflection, asking students to learn some basic knowledge before the scaffolding sessions in the classroom. The solution might incorporate multiple activities and tools upon the problem and situation.
• Use ICT technology to construct the product: at this point, the handed-on ICT tools can be applied to supplement the solutions. For example, the Internet Response System (IRS) might be used during the instruction to seek for students’ ongoing understanding with their personal mobile devices. The online collaborative presentation making could be used for brainstorming, analyzing and creativity.
• Share ideas: this is inter-operational with the third step in the workshop.

3. Lastly, the trainees perform a TPACK-based micro-teaching with the developed instructional activities on the selected topic. The other trainees act as their students and give reflections on the received activities, while the trainers provide the feedbacks for further improvements.

However, after the training workshop process, the trainees have some time to make the improvements for the final instructional activities to address the exact problems in their situations. The implementation phase is expected in the follow-up study.

3. Methods

3.1. Participants

The participants of this study included 43 vocational teachers (male = 14, female = 29) aged between 20 and 60 years old from 11 teaching domains, including General Relations, Fashion, Textiles, Food, Nutrition, Home Economics, Hotel, Design, Arts, Screen Printing, and Communication Technology from a vocational college in Thailand. Each of them has teaching experience at least two years and have attended at least three workshops on training ICT earlier. They attended a vocational teacher training workshop run by our proposed framework for two days (16 hours).

3.2. Instruments and Validation

In this study, a questionnaire was developed to measure the vocational teachers’ perceptions of the effectiveness of ICT competence training. The questionnaire was adapted from (Galanouli Murphy & Gardner, 2004), which consists of nine 5-Likert Scale items to measure the following dimensions: Confidence in using ICT for teaching (CFD), Importance of ICT to teachers (IPT), and Ease of Use the ICT to assist teaching (EOU). The adapted questionnaire was validated for the reliability with the Cronbach’s alpha of 0.866, implying the internal consistency in the measuring items. Example items can be found in the Appendix.

Moreover, an open-ended questionnaire was developed to assess the vocational teacher’s qualitative perspective on using ICT for teaching in the classroom (TCR), and suggestions for the improvement of using ICT in the vocational institution (SIM). The questionnaire was validated, with suggestions, by five experienced ICT technicians, infrastructure engineer and vocational teachers, for the accepted validity.
Both questionnaires were presented in the online version of Google Form to collect the research data during the training process.

3.3. Experimental Procedure

The experiment to measure the effectiveness of the TVET framework was conducted in the 2-day training workshop. Figure 2 shows the experimental procedures with the four following steps:

Step 1: Pre-questionnaire, the vocational teachers answered the online questionnaire with their mobile devices. This aims to collect their personal background and perceptions towards the using of ICT and learning technologies prior to the introduction of TVET framework for 30 mins, as shown in Figure 3 (top-left).

Step 2: Frameworking the TVET framework, they received a training on the technology and applications, e.g. Plickers, Socrative, as shown in Figure 3 (top-right). This step helps equalize the technology skills of the teachers and provides a practical guideline on using the ICT technology effectively. This lasted for seven hours.

Step 3: They were then separated into six groups upon their areas of study and the convenience of collaboration. As shown in Figure 3 (bottom-left), each group brainstorms and found the common problems to address; as a result, the developed instructional activities can be used with all members of a group. At this step, each group followed the PBL process presented in the TVET framework lasted for eight hours.

Step 4: Post-questionnaire, as shown in Figure 3 (bottom-left), individual teachers took an online post-questionnaire, which were in parallel with the pre-questionnaire for the data collection after experiencing the TVET framework. Moreover, an open-ended questionnaire was given to collect more perspectives toward such framework.
4. Research Findings

4.1. Vocational Teachers’ Perceptions towards the TVET Framework

Based on the data collected from the pre- and post- online questionnaires, both data were analyzed to examine the difference of their perceptions towards the TVET framework on three dimensions. As shown in Table 1, it was found that the vocational teachers rated higher on all three dimensions; nonetheless, CFD and EOU were rated significantly higher. This result means that the TVET framework could shift their perceptions on the use of ICT in helping their students’ learning problems, especially regarding confidence and ease of use.

Table 1: Results of pre- and post- questionnaire scores on the TVET framework perceptions.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Pre-Training (n = 43)</th>
<th>Post Training (n = 43)</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>Interpretation</td>
</tr>
<tr>
<td>CFD</td>
<td>3.575</td>
<td>0.884</td>
<td>Moderate</td>
</tr>
<tr>
<td>IPT</td>
<td>4.350</td>
<td>1.788</td>
<td>High</td>
</tr>
<tr>
<td>EOU</td>
<td>4.114</td>
<td>1.145</td>
<td>High</td>
</tr>
</tbody>
</table>

*p < 0.05; **p < 0.001; df = 84

Moreover, when taking gender difference (male and female) onto significant perception difference (CFD and EOU), it was found that female teachers (M = 4.63) could reveal higher perception than male teachers (M = 4.03) on CFD, in contrast to the beginning, while male teachers (M = 4.89) revealed higher perception than female teachers (M = 4.59) on EOU, after attending the training with the TVET framework, as shown in Figure 4. This implies that the TVET framework could provide a strong confidence in using ICT in teaching over the males.
4.2. Vocational Teachers’ Qualitative Perspective and Suggestion towards the TVET Framework

Based on the feedbacks/responses on the open-ended questions, all the responses were analyzed from all 43 participants with a coding technique. The responses could be summarized and presented in Table 2.

It was found that the in-service vocational teachers provided positive feedbacks upon the using ICT for teaching in the classroom as it could increase the learning participation and bring more learning motivation with engaging environment. Moreover, the teachers feed backed several points to be addressed by the institutions for the improvement of using ICT. All teachers’ feedbacks aimed to move the vocational education forwards by seeing the ICT as an essence to drive the learning environments effectively, ranging from the tiny students-teachers-classroom perspective, to the entire infrastructure-institution perspective.

Therefore, the authors have proposed a proposal of practical guidelines and suggestions on vocational teachers’ development in Thailand with ICT. In addition, related studies have been reviewed in supporting this proposal.

Table 2: Results of qualitative feedback on using ICT for teaching in the classroom (TCR), and suggestions for the improvement of using ICT in the vocational institution (SIM).

<table>
<thead>
<tr>
<th>Item</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCR</td>
<td></td>
</tr>
<tr>
<td>1. Participation/Involvement</td>
<td>- The training could make my classroom more active with willing participation.</td>
</tr>
<tr>
<td>(Activeness)</td>
<td>- I can’t wait to see the happy noise in my classroom with the children.</td>
</tr>
<tr>
<td>2. Engagement</td>
<td>- Our developed activities could strongly engage the students in the bored topics for sure.</td>
</tr>
<tr>
<td></td>
<td>- I felt if I finalize the developed plans, the student would get motivated and the most benefit for their better learning performance</td>
</tr>
<tr>
<td>SIM</td>
<td></td>
</tr>
<tr>
<td>1. Technology/Infrastructure</td>
<td>- The college would provide better, stable Internet network for a great learning experience with ICT.</td>
</tr>
<tr>
<td></td>
<td>- I love to see the high-speed Internet, then I can ask student to response me on their mobile without their data plan.</td>
</tr>
<tr>
<td>2. Workloads/Management</td>
<td>- The school should reduce the paper load, so that I can have more time to learn ICT and create better instruction.</td>
</tr>
<tr>
<td></td>
<td>- As always, the timetable management does not support my creativity</td>
</tr>
</tbody>
</table>
3. Incentive/Supports

- The school should consider our effort on taking ICT to enhance the students’ learning outcomes, and offer some more incentive, at least as an encouragement.
- Learning ICT and implementing in the actual course, this could be measured for the promotion.

5. **Guidelines and Suggestions on Vocational Teachers’ Development in Thailand with ICT**

In the last decade, several research studies have been described the contribution to utilize of Information and Communication Technology (ICT) in an educational system that many countries agree that teachers should update their knowledge, skills, and competences. Some have even included professional development in their use ICT for teaching (Vanderlinde, Braak, & Tondeur, 2010; Wastiau, et al., 2013; Kabakci & Çoklar, 2014; Vrasidas, 2015). Many research on Information and Communication Technology (ICT) policy in education have revealed multiple methods concerning design and implementation of policies adopted by many researchers of developing countries especially, in vocational education (McGrath, 2012; Khan, Bibi & Hasan, 2016) that attempted to suggest the government each country in order to improve vocational education system.

In this study, we have found that the vocational teachers do not have methods for applying the technology for teaching and learning while they can use routine technology. In addition, they need to be supported with the facilities such as internet, tablet or device in order to use during the learning process. Vocational teachers need to prepare to integrate ICT in teaching. In the case of an ICT training, even more, concerns have to be considered. The results show that professional development for teachers is most effective if directed to the stage of ICT development reached by the college. We found that the attitude of vocational teachers was improved about using ICT. This can be considered as an important step towards the successful integration of ICT in vocational education.

6. **Conclusions**

This study presented a novel framework to vocational teachers’ professional developments with ICT to address the shortages and flaws of present learning and teaching situations in Thailand vocational context. The TVET framework was proposed by taking ICT and learning technologies as a major tool to be applied in developing the instructional activities for the particular topics upon the teachers’ context. With the TVET framework, the teachers are expected to have TPACK skill of practice through the training workshop process. Besides, PBL was adopted to serve as a concrete structure in developing such needed instructional activities.

Importantly, this research offers a significant contribution to enhancing the quality of vocational teaching and learning with ICT support; moreover, the provided framework could be a leap in advancing the community of technology-enhanced vocational education. As mentioned earlier, this initial version of the proposed TVET framework has just passed the experiment to seek for its effectiveness with only one group of participants. However, continuous improvements can be made upon the follow-up implementations of the ICT-facilitated instructional activities developed during the training workshop, and upon the improvement of the institution’s network, infrastructure and managements. Moreover, the study with multiple groups of participants is required examine the difference among interesting variables and students’ background.

**Acknowledgements**

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References


Appendix

Example of questionnaire items for measuring the teachers’ perception towards the use of ICT in teaching.
1) I feel confident when teaching with ICT.
2) I am generally quite good with ICT.
3) I use ICT in many ways in my teaching.
4) I would generally feel OK trying something new teaching with ICT.
5) I believe I could do advanced ICT for teaching.
6) Figuring out computer problems appeals to me.
7) Learning about ICT is worthwhile.
8) I would like to know more about ICT.
9) All teachers should be able to use ICT in their teaching.
Motivation towards Mathematics Learning in the Technology-enhanced Environment

Shu Ling WONG*, Su Luan WONG

Faculty of Educational Studies, Universiti Putra Malaysia, Malaysia

*shulingjt@gmail.com

Abstract: This paper reviews the motivation construct in mathematics learning, particularly in the technology-enhanced learning (TEL) environment. The discussion here is not limited to a single motivational theory but encompasses multiple facets of the construct. While technology can be effective in motivating students in the learning process, it should not be presumed that motivation can be improved with the mere integration of technology. To enhance motivation in the TEL environment, teachers and instructional designers need to consider students’ current motivational needs as they grapple with understanding mathematical concepts. There is also the challenge of ensuring that initial motivation attributed to the novelty effects of technology be sustained so that students continue to be motivated in the long run. It is important to understand the strengths and limitations of the affordance of technology to complement mathematics learning.

Keywords: Motivation, mathematics, technology-enhanced learning

1. Introduction

Motivation has a pivotal role in mathematics education (Hannula, 2006; Walter & Hart, 2009). Numerous studies have shown that mathematics performance is strongly related to students’ motivation towards mathematics learning (Schiefele & Csikszentmihalyi, 1995; Kim, Park, & Cozart, 2014; OECD, 2014a; Mullis, Martin, Foy, & Arora, 2012). This is evident from the case study of the Programme for International Student Assessment (PISA), a grand-scale international assessment conducted by the Organization of Economic Co-operation and Development (OECD) to measure students’ proficiency in mathematics, science and reading every three years. It was found that highly-motivated students across the OECD countries achieved better scores, equivalent to an additional half year of schooling, than students who were not as motivated (OECD, 2014b). As such, mathematics teachers play a very important role of providing a stimulating environment that will motivate students in the mathematics classroom (Schiefele & Csikszentmihalyi, 1995; Yu & Singh, 2016; Pantziara & Philippou, 2013; Tarmizi & Tarmizi, 2010).

Teachers are urged to revise their teaching strategies to facilitate and improve students’ motivation towards learning mathematics (Thien & Ong, 2015; Ismail & Awang, 2012; Kim et al., 2014). This is where technology comes into the play. Technology has been utilised extensively in education to enhance teaching and learning of mathematics (Star, et al., 2014; Foshee, Elliott, & Atkinson, 2015; Erbas & Yenmez, 2011). Such a learning environment is described as technology-enhanced learning (TEL), where Information and Communication Technology (ICT) is applied (Kirkwood & Prince, 2014). Technological tools or aids can be as general as the Internet connection, computers or laptops, and LCD projectors. They can also be subject specific, examples of which are scientific or graphic calculators, dynamic geometry software, statistical analysis software, and online learning forum or platforms. These technologies can be leveraged to benefit students in mathematics learning. One means by which this is achieved is through promoting students’ motivation towards mathematics. In fact, motivation or affective characteristics have frequently been taken as predictors for mathematics performance (Thien & Ong, 2015; Gilbert et al., 2014; Walter & Hart, 2009; Hannula, 2006; Holmes & Hwang, 2016). This leads then to the role of technology in enhancing these two inter-linked factors, namely mathematics performance and motivation. In other words, when technology is employed intentionally to enhance
mathematics learning, should we presume students’ motivation towards mathematics will be improved as well? Here, the authors review the motivation construct in mathematics education and the role of technology in improving mathematics teaching and learning.

2. Motivation in Mathematics Education

The scope of motivation encompasses what people desire, what goals they opt to pursue and how much effort they are willing to put in to execute their action plans, i.e. motivation explains the magnitude and direction of people’s behavior (Keller, 2010). However, the conceptualisation of the motivation construct in mathematics education has been inconsistent since varying dimensions of motivation have been considered by different scholars. It is crucial to recognise various aspects of the motivation construct in mathematics learning before one can revise strategies to increase motivation.

For instance, self-efficacy (Bandura, 1994) is often associated with motivation in mathematical research (Gilbert, 2016; Skaalvik, Federici, & Klassen, 2015; Holmes & Hwang, 2016; Hannula, 2006; Star et al., 2014; Pantziara & Philippou, 2013; OECD, 2014a; Yu & Singh, 2016). Introduced by Bandura (1994), self-efficacy is about how one perceives his or her ability to complete a task. In a learning context, mathematics self-efficacy is conceptualised as students’ perceptions of their competency to solve or perform mathematical tasks (Skaalvik et al., 2015). Gilbert (2016) analyses students’ motivational level in mathematics learning in terms of self-efficacy and interest in mathematics. Start et al. (2014) also included self-efficacy in the motivational domain when exploring the effects of technology-based activities on motivation in mathematics. As such, students who have high mathematics self-efficacy are deemed to be highly motivated to study mathematics (Skaalvik et al., 2015).

Next, utility value, which is a part of the Expectancy-value Theory (Wigfield & Eccles, 2000), has been derived as motivation in mathematics learning as well (Thien & Ong, 2015; Holmes & Hwang, 2016; Gilbert, 2016; OECD, 2014a). The utility value embedded in the theory refers to the usefulness of a task for one’s daily or future life (Wigfield & Eccles, 2000). In learning mathematics, it refers to the real-life usefulness of the material that is learnt in school. In the case of PISA 2012, students’ perception on the utility value of mathematics in their future career was used to conceptualise instrumental motivation (OECD, 2014a). Gilbert (2016) observes that utility and mastery-approach goals are types of motivation related to the more cognitive-engaging mathematical tasks.

Interest is sometimes equated with intrinsic motivation in mathematics studies (OECD, 2014a; Skaalvik et al., 2015). Intrinsic motivation is defined as the inclination to do things for the sake of the activity itself, which is interesting or enjoyable (Ryan & Deci, 2000). In fact, for PISA 2012, students’ responses on whether they enjoyed and had interest in learning mathematics were adopted as an index for intrinsic motivation (OECD, 2014a). Skaalvik et al. (2015) used intrinsic motivation to represent interest when exploring the relationship between motivation and mathematics performance. This conceptualisation of intrinsic motivation is grounded in the Self-determination Theory (Deci, 1972) which argues that interestingness of an activity is dominant in intrinsic motivation, where interest exists between an individual’s intrinsic needs (i.e. competency, autonomy, and social-acceptance) and affordance of the activity. This suggests that one is intrinsically motivated when engaging in the activity that one is interested in.

In contrast, Hannula (2006) conceptualises motivation as a potential that cannot be directly observed. The potential refers to the force that is driven by needs and goals which are also affected by emotions at the same time, and which eventually navigates one’s behaviour (Hannula, 2006). Kim et al. (2014) state that motivation should be viewed as a part of emotion, and vice versa. In other words, students’ emotions, attitudes and beliefs can affect the degree of perseverance in the pursuit of goals, i.e. better grades in mathematics or mastery of mathematics.

Thus far, various aspects of the motivation construct have been discussed in the context of mathematics learning. It has been related to self-efficacy, utility value in the Expectancy-value Theory or instrumental motivation, intrinsic motivation in the Self-determination Theory, as well as interest, beliefs and emotions. Therefore, the discussion of the motivation construct in
mathematics learning in this paper is not restricted to a single motivational theory but encompasses multiple facets of the construct.

3. **Student Motivation and Mathematics Performance**

As mentioned earlier, previous studies have established the correlational relationship between motivation and mathematics performance (Gilbert et al., 2014; Walter & Hart, 2009; Hannula, 2006). According to PISA 2012, the relationship was better established among students who performed at an outstanding level than among lower performing students (OECD, 2014a). By adopting results from PISA 2012, Thien and Ong (2015) reported that mathematics self-efficacy and anxiety had a statistically significant effect on Malaysian students’ mathematics performance. Skaalvik et al. (2015) state that mathematics self-efficacy could make a difference in students’ mathematics performance while Holmes and Hwang (2016) suggested that motivation was one of the factors that contributed to mathematics success when exploring the effects of project-based learning in mathematics. Walter and Hart (2009) reported that students chose to act when motivated by tasks that had a bearing to the social and personal context. This eventually fostered the students’ engagement in mathematics learning. Hannula (2006) carried out a case study to observe students’ motivational behavior in relation to mathematics performance. The study concluded that students’ needs and goals directed their motivational behavior, which eventually affected their mathematics learning. Students who focused on impressing their teacher (i.e. performance goal) were less likely to involve themselves in mathematical exploration (i.e. learning goal), and consequently this affected their decision to learn (Hannula, 2006). Also, Gilbert (2016) revealed that students with greater interest in mathematics and higher mathematics self-efficacy experienced fewer negative emotions, and their performance varied with the cognitive level required.

In short, motivation has a vital role in mathematics learning. The following part of this paper moves on to describe in greater detail motivation towards mathematics in the TEL environment.

4. **Motivation towards mathematics in the Technology-enhanced Learning Environment**

ICT has been used increasingly in mathematics education to enhance teaching and learning. It is intended that, along with these efforts, students’ motivation towards mathematics would be improved as well. Therefore, it is important to ask what aspects of technology should be considered to enhance students’ motivation, particularly towards mathematics learning in the TEL environment.

Erbas and Yenmez (2011) used a dynamic geometry software (i.e. Geometer’s Sketchpad) to provide a computer-supported and student-centered collaborative inquiry learning environment to help elementary school students improve learning about polygons. The qualitative results revealed that students in the experimental group, unlike those in the control group, showed higher interest and motivation towards learning geometry based on the amount of time spent in the computer laboratory. However, the study also noted that the students’ positive attitudes might be associated with the novelty effects of using technology (Erbas & Yenmez, 2011). Hannafin, Burrus and Little (2001) reported similar results where students’ interest and attitudes towards geometry seemed to be changed positively during student-centered learning activities using dynamic geometry software. Nevertheless, their teacher observed that the novelty effects faded faster among lower mathematics proficiency students in the middle of the second week of the study (Hannafin et al., 2001). Therefore, it is important and necessary to take into account the possibility of novelty effects of technology wearing off by and to design strategies to sustain the motivation to learn mathematics.

Next, Kim et al. (2014) studied affective and motivational factors of learning in an online mathematics course. The results indicated that mathematics self-efficacy is a predictor of mathematics achievement, but that was not the case when achievement emotions (i.e. enjoyment or
anxiety) were considered in the virtual learning environment. Thus, it was suggested that since students’ emotions play a part in motivation and achievement of learning, enhanced social presence could regulate their emotions and improve the cognitive process (Kim et al., 2014). The results supported those obtained by Clayton, Blumberg and Auld (2010) who found that most students, when asked to choose among traditional, online or hybrid learning environment, preferred a learning environment that matched their learning style, i.e. one that offered engagement and interaction with the teacher and fellow students. Therefore, it is important to recognise the need for social presence in the learning environment, especially for instance, in a technology-enhanced learning environment. This implies that technology (e.g. relational agent) could be leveraged to facilitate and regulate emotions to enhance motivation in the virtual mathematics learning environment (Kim et al., 2014). The computer artefact should be designed to build a socio-emotional relationship with users, in this case, to regulate emotions of the students in the virtual learning platform (Campbell, Grimshaw, & Green, 2009). The authors of this paper do not intend to review the relational agent in detail but to raise the point that technology might be able to afford opportunities to regulate students’ emotions and motivation.

In another study, Star et al. (2014) examined technology-based strategies to enhance motivation in mathematics. Three technology-based strategies were used, each differing in terms of the type of motivation construct, the level of expenses, and technical sophistication. First, students were provided with an immersive virtual environment to promote self-efficacy by introducing game-like mathematical activities. Second, students were engaged in a web-based activity that did not contain any mathematical content but was aimed at changing their views on learning ability from fixed view of ability to incremental view of ability. Lastly, students watched a 56-minute mathematics-related video which could be considered an affordable and straightforward technological teaching tool, without any intention to improve any particular motivation construct. In terms of mathematics learning, the interventions had modest effects on students’ mathematics scores which saw moderate gains (Star et al., 2014). Rather unexpectedly, students’ self-efficacy did not improve significantly and students’ incremental view of ability was found to be low (Star et al., 2014). The study highlighted the critical need to provide a motivational experience that could be adapted to the students’ current developmental level (Star et al., 2014). Thus, it is suggested that an adaptive or individualized instruction is needed if technology is to be used as a motivational tool.

With regard to adaptive or individualised instruction, Foshee et al. (2015) used TEL to facilitate an individualised, adaptive, and mastery-based instruction for a college mathematics remedial class. TEL, in this case, was a highly developed software programme for mathematics learning. It is important to note that the adaptive instructions in the study referred to the process of determining the most suitable learning path for students by using thousands of data points that were from a constant assessment of students, and hence, individualised instructions were prepared for each student. The results showed that the adaptive TEL significantly improved remedial class students’ mathematics scores as well as the perception of their ability in mathematics, which was conceptualised as mathematics self-efficacy. Foshee et al. (2015) concluded that repeated success experience had increased students’ expectancy for success, thus changing their perception of their own mathematics ability. Surprisingly, students’ motivation was significantly decreased, with motivation in this study being conceptualised as manifested behavior like participation in the class, being responsible for own learning and preparing for exams. Foshee et al. (2015) were of the view that the structure of the adaptive instruction system had lowered students’ self-initiated behavior because the programme offered the learning path for them, i.e. making it easier for them to learn but not adequately motivating them. Thus, their motivation decreased. Nevertheless, Foshee et al. (2015) acknowledged the ability of TEL to improve students’ self-efficacy.

Another technological tool, a 3-dimensional instructional game, was developed and used as a supplementary aid in mathematics lessons to improve students’ achievement and motivation (Bai, Pan, & Kebritchi, 2012). The specially designed instructional game was aimed at enhancing motivation by stimulating students’ curiosity, helping them develop a clear learning objective throughout the game, and encouraging them to be persistent in the process (Bai et al., 2012). The study revealed that while students subsequently increased their knowledge in algebra, there was only a slight increase in motivation for the treatment group, while motivation was decreased in the control group. Bai et al. (2012) argued that the results were in line with literature in that they
reflected students’ refusal to learn mathematics when it got more difficult and it became a challenge to motivate students to learn mathematics.

Taken together, these results provide important insights into the motivation construct in the TEL environment. Apparently, the novelty effects of technology could be mistaken for motivation to learn (Erbas & Yenmez, 2011; Hannafin et al., 2001). More importantly, social presence is needed in TEL to motivate students as they need to interact with their peers in order to improve learning (Kim et al., 2014; Clayton et al., 2010). It should be noted that when mathematics achievement is improved with the integration of technology, it does not mean that students are more motivated to learn (Kim et al., 2014; Star et al., 2014; Foshee et al., 2015; Bai et al., 2012). In other words, in the TEL environment, it is necessary to have strategies to improve and sustain motivation. However, there is no need to choose between scaffolding cognition (i.e. learning mathematics concepts) and motivation (Belland, Kim, & Hannafin, 2013). Specially designed adaptive instructional learning software could help remedial class students by providing motivating learning experiences and reinforcing their self-confidence when they experience repeated success (Foshee et al., 2015). Moreover, technology tools could also complement the teacher’s role (Bai et al., 2012; Star et al., 2014) by providing a virtual learning environment where the instructor plays a supplementary role sometimes (Foshee et al., 2015; Kim et al., 2014). In either role, it is envisaged that technology could be leveraged to facilitate motivation towards mathematics.

5. Conclusion

In general, the literature suggests that technology is an effective tool for mathematics teaching and learning while potentially it can be a motivational tool as well. Nevertheless, whether or not technology can be used to enhance motivation in TEL depends on several considerations. For instance, the novelty effects of technology should be cautiously controlled in future research design to ensure that they do not affect the level of students’ motivation in the long run. It should not be taken for granted that motivation will be enhanced when technology is used in mathematics learning. This implies the need for educators and policy-makers to understand and exploit the affordance of technology as a tool to improve mathematics instruction but not necessarily for motivating students to want to learn mathematics. It is also important to decide whether technology should play a supplementary or primary role in mathematics instruction at various levels of education, taking into account the motivational needs of students as well as the importance of social interaction in the classroom. In other words, the frequency and the extent to which technology would be used in classroom instruction should be complementary to the needs of students. The integration of technology itself cannot take care of motivation and learning in the TEL environment. The teacher or instructional designer should ensure that there is social presence as well so that learning can be meaningful and effective.

It is noteworthy that many studies have emphasized mathematics self-efficacy as one of the most critical motivational factors in mathematics learning. In this regard, TEL can be used to enhance students’ self-efficacy, for instance, it provides repeated success in students’ mathematics learning via adaptive software programmes. In other words, motivational factors in technology-enhanced mathematics learning can be improved by identifying students’ present motivational problems beforehand. Instructional designers then can opt for the most suitable and available materials and tools for the instruction. Nevertheless, TEL should not replace the student’s role in learning; self-initiation to learn and awareness about his or her own responsibility in the learning process are vital to building up motivation to learn. Therefore, TEL should be complementary to the student’s motivational needs in the mathematics classroom. To conclude, while TEL has the potential to enhance motivation to learn, it is important to bear in mind its affordance as well as its efficacy as a supplementary or main instructional tool in the long run.
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What Influence Teachers’ Satisfaction Towards E-Learning? A Synthesis of the Literature

Mei Lick CHEOK, Su Luan WONG, Mohd Ayub AHMAD FAUZI & Mahmud ROSNAI

Malay Women Teacher Training Institute, Melaka, Malaysia
Universiti Putra, Malaysia
janecheok88@gmail.com

Abstract: The e-learning system being used in the Malaysian schools is known as the Frog Virtual Learning Environment (VLE). The availability of the system has allowed for blended learning to take place. However, there is an obvious gap between the enthusiasm of the Ministry and results of some studies carried out that have shown a poor uptake of the Frog VLE in schools. Levels of adoption of the VLE by the teachers have been disappointing. This paper investigates factors that are critical in influencing satisfaction towards the Frog VLE. As satisfaction influences continuation of future usage intention and behaviour, it makes sense for policymakers and relevant stakeholders to know and understand factors that could bring about teachers’ satisfaction.

Keywords: satisfaction, teachers, virtual learning environment

1. Introduction

A comprehensive review of the education system in Malaysia found that despite the massive expenditure on the Smart School; an ICT project which started in 1999 and completed in 2010, 80 percent of the teachers used ICT less than an hour per week (as cited in Ministry of Education, 2012). Even when ICT was used, it was limited to word processing applications. The review process preceded the formation of the Malaysian Education Blueprint (MEB). This Blueprint is a document that provides the vision of the education system which the country needs and deserves. It suggests 11 strategic and operational shifts in order to achieve the vision. One policy shifts stated in the MEB is to leverage on ICT in order to improve the learning quality across Malaysia. As a result 1BestariNet project was created in order to provide access to a single learning platform and a high-speed 4G internet connectivity to all 10,000 schools nationwide. All the schools in Malaysia have internet access and a learning platform via the 1BestariNet project. The learning platform provides a cloud- based virtual learning platform known as the Frog VLE, a United Kingdom’s designed application created to ease lesson plan development, facilitate administrative tasks, and allow students to access learning resources.

Despite the enthusiasm, RM663 million spent on the 1BestariNet project, it is suffering from lack of usage (National Audit Department, 2013). There has not been corresponding increase of usage in technology among the teachers. The report revealed that usage of the FROG VLE by teachers, students and parents was between 0.01 percent and 4.69 percent. Daily utilisation of the VLE by teachers was found to be between 0.01 percent and 0.03 percent. This suggests that the VLE is hardly used by most teachers. Irfan Naufal Umar and Mohd Tarmizi Mohd Yusoff (2014) in their study highlighted Malaysian teachers as being highly competent in using the internet application for searching and sharing information, using the word processor, spreadsheet and slide presentation but they lacked the skills in doing the more advanced applications like producing graphics, animations and multimedia design. The biggest challenge to e-learning seems to be the lack of competent academics, whereby nearly two third of academic
members in the public universities have reported low motivation to incorporate e-learning tools in their teaching and learning (Adnan & Zamari, 2012).

Policy makers need to do away with the beliefs that by providing access to the e-learning, it would lead to major changes in the classroom teaching and learning. The presence of a new innovation despite its promises of greater benefits, does not automatically translate into actual usage. This proves that the cause of failure or lack of usage is still poorly understood.

2. **End User Satisfaction**

End-user satisfaction is a concept which suggests that an information system which meets the needs of its users will reinforce satisfaction towards the system. Satisfaction of users towards their information system is a potentially measurable and generally acceptable, surrogate for utility in decision making. End-user satisfaction does not only measure a system’s success, it also looks at how users view their information system rather than the technical quality of the system. So no matter how good a system is, if users perceived it as poor, then it is considered poor. If the system does not provide the required needs, it will create dissatisfaction and forces the users to walk away from the system. Some findings from recent studies also indicated that users are rarely satisfied with the functionalities of new e-learning systems and are worried with the problems of integrating the system with other organisational systems (Russell, 2005). User dissatisfaction with newly introduced systems, mismatches between a new technology and existing work practices, underestimating technological complexity and inefficient end-users support are just some of the many issues raised concerning the e-learning (Bondarouk, 2006). Users’ satisfaction towards their information system is a measurable and acceptable surrogate for utility in decision making instead of its technical quality (Bai, Law & Wen, 2008).

Users’ satisfaction is not a new concept as many studies have been carried out in an effort to understand its antecedents and consequences. However, current studies are needed as situations and environment are fast changing. Now, we hardly find users who interact with service personnel, instead users are dealing directly with the technology adopted. So new findings are needed to find out what affect users’ perceptions of quality and the values that they placed in their interactions with the technology in place. Factors that lead to satisfaction are often difficult to be isolated and recognized, due to their complex inter-relationships (Mahmood, Burn, Gemoets, & Jacquez, 2000). Despite that we still need to examine teachers and beliefs they hold about teaching, learning and technology. Integration of computers in the educational system will never be possible without reconciliation between teachers and computers. To encourage teachers to use computers, we need to study teachers and what make them use computers. Research into the factors that predicts satisfaction could shed light into what the teacher training division and management need to focus, what aspects matter most to their teachers in order to encourage continuous and increased participation and usage.

3. **Research Method**

A comprehensive search of satisfaction on eLearning literature from 2000 to the present was conducted by the author. Articles from journals, books and conferences relevant to the topic were identified and selected for this review using the following criteria. Key concepts from the studies were translated into the literature review.

4. **Factors that lead to Satisfaction among Teachers**

Teachers in general face various glitches and challenges as they learn to use and familiarize themselves with any new technological instructional activities in the classroom. System satisfaction is defined as a cognitive discrepancy between the feelings prior to and after the use of system; when users obtain a better feeling after using the system, they will be satisfied and be willing to continue to use the system (Doll & Torkzadeh,1991). When users’ satisfaction falls short
of their expectations, psychologically, they will reject the system and will refrain from using it (Seddon, 1997). Factors affecting end user satisfaction are of critical importance to researchers. It is important to recognize and discuss major determinants of satisfaction in order to be able to have a better understanding of the phenomenon. The predictors most widely studied and related to satisfaction among teachers are computer attitude, internet self-efficacy, computer anxiety, perceived usefulness, perceived ease of use, interaction, flexibility, school management support, training and internal ICT support. These ten factors are grouped under three headings. Teachers’ characteristics include computer attitude, computer anxiety and internet self-efficacy, while learning management system characteristics will focus on perceived use, perceived ease of use, interaction and flexibility. Finally, if we expect to see growth in e-learning, in the Malaysian education landscape, then the intangible things like perception of the users; specifically the teachers are equally important as the infrastructure.

4.1. Organisational Characteristics

The responsibility of today’s educational leaders is to identify, design and implement appropriate paradigms that are capable of using this mechanism to bring the vision as established in our Malaysian Blueprint to fruition. The importance of the interplay between the organisation and the adoption and implementation of new technology cannot be underestimated. Organisational support represents the degree to which employees perceive that their employers support their participation in the development activities and value their learning through supportive organisational policies such as skill-based pay systems and visible rewards. In accordance with the technology acceptance model, facilitating conditions like training and financial resources have been found to have a direct effect on perceived usefulness when using a system (Wang, Lin & Luarn, 2006). However, a study by Teo and Wong (2013), showed no direct influence of facilitating conditions (training, technical support, peer and organisational support) on satisfaction. Therefore, an understanding of organisational contributions to the success of technology innovation is important as it can better prepare educational leaders to embrace the responsibilities that are required of them.

4.1.1. School Management

Management in schools must create conditions in which educators can continue to grow and learn as professionals. Management support is the key factor in determining teachers’ satisfaction towards LMS. Their opened approval, and clear identification of how LMS aligned with the school’s vision, are just some of the examples of how management can encourage adoption. A number of past studies have revealed significant relationship between supportive learning environment and satisfaction (Joo, Joung & Son, 2014). The environment as dictated by the management in schools, are crucial, as it facilitates the diffusion process of an innovation. School administrators are seen as key in the implementation of e-learning environments in their schools. It is because through their leadership, provision of training, tools and support can be provided for their teachers. These are essential for a successful implementation. There is a consensus in the literature that management must define a clear strategy for any innovation that would be introduced in order to provide that vision of a common goal. A clear and a well-communicated strategy can help to avoid fragmented and small pockets of adoption (Stiles & Yorke, 2006). Therefore, lack of institutional support may hinder the widespread adoption.

4.1.2. Technical Support

Technical support is deemed essential in the use of a learning management system (Zhao & Bryant, 2006). Without having a quick technical support or knowledge, it may lead to problems and frustrations among the users. Troubleshooting skills are important if ICT is to be used as a reliable tool. Besides relying on technical support alone, teachers are also expected to be self-reliant and to take the initiatives to improve their capabilities. Technology support has been found to have great impact on educators’ use of technology as it can boost technology use and acceptance, thus increase likelihood of ICT integration in the teaching and learning processes.
(Sanchez & Hueros, 2010). Teachers need a reliable on-site technology support for their day-to-day use of ICT. The paper also found a significant relationship between technical support and professional development which suggests that technical personnel can help teachers to grow and develop their knowledge and skills as the integration process develops.

4.1.3. Training

End-users come replete with ingrained habits of feelings, thoughts and actions (Nelson & Cheney, 1987). To change through training, their normal habits have to be questioned first. Introduce other methods which allow users to experiment with new ways of behaving. Thus, if they find this new way to be more useful, chances are they will continue with this new behaviour. Therefore, trainings designed for end-users must consider their specific job performance’s needs and job satisfaction. This must be taken care of before providing them with the most relevant and efficient system and training programmes that are appropriate in their context (Lee, Kim & Lee, 1995). A large amount of training and support for users are needed to help them to be comfortable with the new system and to train them to effectively use ICT in the classroom (UNESCO, 2014). Faculty members were not eager to integrate technology into their classes due to their technological incompetence. They need to be guided in order to overcome their own fears of technology. Knowledge and skills obtained from training, empower teachers to carry out their work effectively and efficiently and this will result in a positive effect on end-user computing satisfaction (Aggelidis & Chatzoglou, 2012).

4.2. Virtual Learning Environment Characteristics

Many studies on the use of VLE has focused on the relationship between VLE quality and satisfaction with the system as information and system quality have been shown to influence satisfaction (Bailey & Pearson, 1983; DeLone & McLean, 1992). Instructors’ satisfaction towards the VLE may be impacted to a great extent by system quality. The more functionality and interactivity for example, the better will be its acceptance and utilization. As such, designers should continuously look for opportunities to further improve e-learning platform even those that have already been implemented. A number of characteristics of a system have been proposed and examined in prior studies.

4.2.1. Interaction

Interaction is the key to the continued use of an e-learning system (Pituch & Lee, 2006). Although there are a few studies that suggest otherwise, many other studies claimed it to be a key component of an effective online course (Arbaugh & Rau, 2007). In some studies which looked at student-student interaction, they claimed that interaction helped in creating a sense of community which is an important aspect for the teachers especially when having to learn and use a new innovation in their classrooms (Liu, Magjuka, Bonk & Lee, 2007). Collaboration resulted from interaction between students and instructor or between students through the email, bulletin board and the chat room on the VLE have been found to increase students’ satisfaction (Lonn & Teasley, 2009). When students are involved in intellectual exchange with their fellow peers and instructor, they are given the opportunity to articulate their current understanding and refining that understanding after knowing what the others in their online community have in mind. A study which looked at three types of interaction; learner-content, learner-instructor and learner-learner were studied in an attempt to identify predictors of satisfaction in online education courses (Kuo, Walker, Schroder and Belland, 2014). It found learner-content and learner-instructor to be significant predictors of student satisfaction but learner-content was found to be the strongest predictor of the three.

4.2.2. Flexibility

Flexibility is also crucial in promoting satisfaction as it gives students that anytime anywhere access to course content (Selim, 2003). In e-learning context, flexibility in terms of time, location, instructional methods, participation and satisfaction are to be expected. Amongst others, it
eliminates physical barriers and awkwardness of the traditional face-to-face communication. Lu and Chiou (2010) conducted a study on the impact of contingent variables between four predictors and students’ satisfaction with e-learning. They found three significant predictors of e-learning satisfaction, perceived flexibility is amongst them. In another study, Sun et. al. (2008) found flexibility is a strong indicator of student satisfaction. This is explained by the fact that many respondents were in continuing education; balancing job, family and work-related activities. Not constrained by time, space and location, students have a high degree of flexibility when enrolled in an e-learning course. Arbaugh (2000) examined factors related to student satisfaction with internet-based courses among students who were doing their graduate management in education. It also found that flexibility had a significant role in predicting satisfaction towards the courses. Flexibility-based advantages like any time and any where are important features for distance-learning mature students in this study.

4.2.3. Perceived Ease of Use

Perceived ease of use refers to the degree to which an individual believes that using a particular system would be free from physical and mental effort (Davis, 1989). It is often considered as a predictor of satisfaction (Aggelidis & Chatzoglou, 2012). The complexity of an information system will definitely hinder acceptance of the system. A study carried out by Teo and Wong (2013) to explore key drivers of e-learning satisfaction among student teachers and found six variables that influence e-learning satisfaction; satisfaction, instructor, perceived usefulness, perceived ease of use, course delivery and facilitating conditions. Analysis of findings confirmed the significant direct influence of perceived ease of use on satisfaction, and it is also has the strongest influence. As such, the researchers suggest e-learning conditions to be managed in such a manner that users need not use much effort to utilise the system. However, they also caution the interdependence of all the variables studied, which means no variable was independent of each other. Therefore, understanding of the key drivers of e-learning satisfaction is important as it will help stakeholders to further maintain or sustain the e-learning satisfaction.

4.3. Perceived Usefulness

Perceived usefulness is defined as the degree of improvement after adoption of a system. When users perceive e-learning to be useful in acquiring the desired skills and knowledge, they are more likely to use the system. Previous studies have shown that perceived usefulness has a positive usefulness on users’ intention to use a particular system (Luan & Teo, 2009). It has also been shown to have a direct impact on satisfaction (Sun, Tsai, Finger, Chen & Yeh, 2008). A study has found teachers’ behavioural beliefs positively predict the usefulness and ease in which the e-learning is used and they found perceived usefulness significantly influenced student teachers’ satisfaction with e-learning (Kao & Tsai, 2009). A study looking at four variables believed to have an impact on website satisfaction and intention to re-use; information quality, system quality, perceived usefulness and social influence. They found perceived usefulness to be a significant predictor of website satisfaction (Schaupp, 2010). They suggest organisation to understand users’ needs in order to design a website that would be considered relevant and useful. As they found satisfaction to be a significant predictor of intention to re-use, aligning website designs to users’ needs is the most appropriate thing to do.

4.4. User Quality

Users form different perceptions of an e-learning system due to individual attributes. Individual characteristics have been found in previous studies to influence instructors’ adoption of the learning system (Teo, 2009). There is a need to examine the opinions of the instructors and their beliefs as their beliefs will influence their technology integration practices (Ottenbreit-Leftwich et al., 2010). In this study, computer attitude, computer anxiety (Harrison & Rainer, 1996) and internet self-efficacy are posited as three factors that are expected to influence satisfaction towards e-learning.
4.4.1. Computer Attitude

Technology-push approaches must consider users’ individual differences, personal characteristics, opinions and learning styles (Akkoyunlu & Yilmaz-Soylu, 2008). The attitude that end-users bring in dealing with the e-learning environment is an important factor (Albirini, 2006). Those who have positive attitudes toward technology are more comfortable in using it and thus, are prepared to overcome any challenges. Significance of attitude was derived from the proposition of attitude theorists, Fishbein & Azjen (1975) who claim that users’ attitude towards the system that they are using play an important role in influencing their subsequent behaviour towards it. Attitude represents beliefs and feelings that they have towards something. The more positive they are towards the LMS, and they are not afraid of the challenges and complexity of using the system, the more satisfied they will be with the VLE. However, research also caution that attitude can either be changed through training (Pancer, George & Gebotys, 1992) or it can also be stable and unchanging. Igbaria and Nachman’s (1990) study found significant relationship between attitude and user satisfaction. According to the Theory of Reasoned Action, an individual’s attitude towards an object plays an important role in influencing his or her subsequent behaviour towards it. As such, we can conclude that teachers’ attitude towards the Frog VLE is an important indicator of satisfaction.

4.4.2. Internet Self-Efficacy

Self-efficacy reflects one’s beliefs about the ability to perform certain tasks successfully (Bandura, 1977). Unless teachers believe that they are capable of implementing the innovation in the classroom, that innovation will remain intact and unused. Those who believe strongly in their own ability will persevere despite setbacks and will continue in spite of technical difficulties. It is a belief that one has towards one’s own capabilities in performing a particular task (Compeau & Higgins, 1995). Success in using the technology will depend on users’ ability to cope with technical difficulty and it is a testament of their confidence in using technology to engage in learning (Gunawardena, Linder- VanBerschot, LaPointe & Rao, 2010). Kuo and Tseng (2014) in his study of 221 graduate and undergraduate students found that Internet Self Efficacy was not a significant predictor for student satisfaction although positive correlation between them was found. On the other hand, Gunawardena et al. (2010) examined factors that predict learner satisfaction and transfer of learning in an online educational programme at a multinational corporation. They found online self-efficacy to be the strongest predictor of learner satisfaction. Some other past studies have also found different roles of self-efficacy in an online learning like being the only statistically significant variable that predict learners’ intent to participate in future web-based courses and to show acceptance of online education in high-tech companies among employees (Ong, Lai & Wang, 2004).

4.4.3. Computer Anxiety

Anxiety or fear of computers is described as a powerful and widespread psychological phenomenon (Igbaria & Parasuraman, 1989). Computer-related anxiety remains an important issue as the number of online courses have increased over the past few years. Fear and panic inflicted whenever one has to deal with the system will naturally hamper one’s satisfaction level. According to Barbeite and Weiss (2004), anxiety is an emotional fear of potential negative outcomes. A study examining key factors that influence 82 instructors’ satisfaction of LMS in blended learning found that amongst others, instructors’ computer anxiety negatively impacts satisfaction of LMS. It also found that this variable was the key factor in influencing instructors’ satisfaction of LMS. The study proposed for organisations to investigate the causes of computer anxiety in order to eliminate it if they want to improve the adoption of LMS in their organisations Al-Busaidi and Al-Shihi (2012).

5. Satisfaction Model
This paper proposed a model (Figure 1) in studying teachers’ satisfaction towards the Frog VLE. This paper has identified critical factors that could ensure successful e-learning implementation through better uptake of the learning management system. These factors include user’s or in this paper, the teacher’s characteristics which include aspects like computer anxiety, computer attitude and internet self-efficacy; the Frog VLE’s characteristics which involve aspects like interaction, flexibility, perceived usefulness, perceived ease of use and lastly the organisation’s characteristics which focus on training, technical support and school management.

6. Conclusion

Still at its infancy stage of the web-enhanced learning environment in the Malaysian educational environment, more studies that look at teachers’ satisfaction towards the Frog VLE is crucial because ultimately any educational change will depend upon what teachers think and do. Cuban (2001) observed that teachers will use technology based on their personal perspectives. As technology adoption lies within the teachers’ goals and perceptions, teachers’ satisfaction towards the Frog VLE will determine their continued usage. Implementation from top-down without considering their satisfaction will result in dissatisfaction. Social, psychological and learning management system do have a bearing on their satisfaction towards the FROG VLE. Consideration of these factors are necessary in order to ensure sustainability and scalability of the 1Bestari project.

References


Teacher Identity: Influence of Emerging Trends

Arit UYOUKO*, Sylvester Dominic UDO & Doris Godwin ASUQUO

College of Education, Afaha Nsit, Nigeria

*uobonganwan@rocketmail.com

Abstract: Using a qualitative research method, the study aims to analyze the teacher identity and how such an identity is being influenced by current technology trends in educational practice. Sample of the study was composed of five teachers, with teaching experiences of 8 to 10 years. The interview technique was used as the data collection instrument. The recorded interviews were transcribed and analysis was carried out on this dataset. The result showed that teachers form their professional identity based on the expectations and conditions after they take up appointment as teachers, identities continue to change and develop along practice, societal recognitions, as well as life experiences. Further, findings of the study are discussed as reflection of teachers’ work environment and development.

Keywords: Teachers’ identity; teachers’ professional development; technology, ICT.

1. Introduction

Teachers in the 21st century are different from years gone by. The forceful growth of Information and Communication Technology (ICT) in education redirects the focus of teaching and learning. The emergence of technology in the classroom has opened up a whole new world of investigation into the issue of effective teaching (Rahimi & Yadollahi, 2011). ICT plays a significant role in facilitating educational change reforms, teachers therefore have become the agents of change. As agents of change, if teacher become ICT literate, they would make a lot of positive attitude to computer use and information technologies (Kpai, Joe-Kinanee, & Ekeleme, 2012). Beijaard, Verloop, & Vermunt (2000), maintains that teachers' perceptions of their own professional identity affect their efficacy and professional development as well as their ability and willingness to cope with educational change and to implement innovations in their own practice about teaching. One major rationale behind the ICT’s failure in teaching is teacher resistance to ICT. Carnoy (2014) argues that difficulties are the consequences of the lack of training, as many teachers feel uncomfortable because they do not have both the necessary ICT abilities and the specific training to use the new resources in the classroom environment.

Research studies have repeatedly put forward the question as to what variables determine the integration of ICT in teaching and learning (Jo Tondeur, Keer, Braak, & Valcke 2010). A number of studies have shown that teacher factors play a key role towards ICT integration in schools, research in ICT integration have failed to focus on the teacher identity building and teacher resilience in the face of change. Changing teaching practice is a challenging and laborious process that involves changing teachers’ existing beliefs and individual disciplines, in teaching and learning as well as reshaping their professional identity (Schutz, Cross, Hong & Osbon, 2007). Emerging new ways often involves teachers’ transition from traditional —“talk and chalk”, teacher-centered approach to student-centered and inquiry based instructions. Teachers have a key responsibility for their professional development, for they must realise that self-motivation and interest are the underlying factors for success in professionalism. This is especially important in areas of rapid change such as the educational application of ICT and the use of networks and other ICT innovations to support the flow of knowledge that is crucial in enhancing teaching capabilities (Albion, Tondeur, Forkosh-Baruch & Peeraer, 2015).

Therefore, Leask and Younie (2013) question then, if teacher quality is accepted as a critical factor in educational outcomes, why is there so little attention paid to improving the quality
of teachers’ professional knowledge for ICT integration. In view of the rapid changes occurring in ICT and the relative lack of related transformation in education, the need for effective Teacher Professional Development (TPD) in relation to ICT is apparent but it is less clear what TPD would be most beneficial and how it should be most effectively delivered (Albion, Tondeur, Forkosh-Baruch, & Peeraer, 2015). Gaps in usage and outcomes have been identified globally. Some of these gaps may be explained in terms of teachers’ digital competence and ICT acceptance. Learning and developing a craft of teaching is an ongoing process throughout a teachers’ teaching career. With the fast pace of technology changes globally, one area of development employers expect to see in teachers’ practices is an up to date use and knowledge of ICT tools in teaching and learning, an expectation teachers need to address throughout their practicing career. The study aims to explore two key research questions:

i. How does teacher professional identity affect ICT Integration?

ii. What influences a teachers’ resilience?

2. Teacher Identity

Teacher identity is conceptualized generally as complex, dynamic, evolving, and emergent (Beijaard, Meijer, & Verloop, 2004). Trent (2014) views that teacher identities are created and recreated over time and influenced by an array of factors. Teachers are confronted with multi-faceted, constantly shifting, and unstable definitions of themselves. Pillen, den Brok, and Beijaard, (2013) further explains that the process of identity creation takes place throughout a working life, it is in pre-service and early-career stages where identities are most volatile, tensions experienced in teacher education commonly continue into early-service practice. The processes of reconciliation of the personal and professional dimensions of what it means to be a teacher are conflicts that can have consequences not only for current learning but also longer term career (Henry, 2016). Teacher “identities refer to the different views that individuals have about themselves as teachers in general, and how this view changes over time and in different contexts” (Dworet, 1996, p.67). Beijaard Verloop and Vermunt (2000) propose an idea where teachers’ professional identity is a framework established and maintained through the interaction in social situations, and negotiation of roles within the particular context. Cross and Hong (2009) explain that, the way teachers perceive themselves influences their choice of action and judgment, thereby making identity a critical factor in understanding teachers’ classroom behaviors.

For teachers, their professional identities embody how teachers view themselves in their instructional role and how they represent themselves to their students and colleagues. These mental representations of themselves are intimately intertwined with emotions. What teachers believe constitute knowledge and the process through which students obtain this knowledge informs the ways they manipulate learning in the classroom and their responsibilities in the teaching learning process. The teacher’s professional identity is an essential element in understanding teachers’ behavior, judgment, and subsequent emotional experiences in the classroom. Implementing reform policies and practices ultimately ask teachers to reshape their professional identities by adopting different roles and perspectives. Several studies have noted this procedure, and emphasized teachers’ professional identity as one of the most important factors for successful implementation of a reform agenda (Cross & Hong, 2009). The importance of teacher identity, the experiences of individual teachers, how they go about their work and how this influences their professional practice will be investigated in this study.

2.1. Teachers’ Resilience

Resilience is understood as dealing with a process (Bobek, 2002; Masten, Best, & Garmezy, 1990), a capacity or ability to resist and overcome challenges (Sammons, Day, Kington, Gu, Stobart, & Smees, 2007). The definition of resilience is multidimensional and complex. There is no universally accepted definition of resilience, but there are some defining and determining features such as bouncing back, overcoming adversity, adapting oneself. It is resilience that represents the capacity of teachers to rebound and understand the necessity for change and adaptation despite being through difficulty. Teacher resilience has three components; first, is the
individual teacher’s capacity to harness not only personal or psychological resources but also physical, social, and cultural resources. Second, is the process whereby characteristics of individual teachers and of their personal and professional contexts interact over time. Thirdly, resilience is evident in the outcome of a teacher who, despite facing challenges, experiences professional commitment, growth, wellbeing, and a “strong sense of vocation, self-efficacy and motivation to teach” (Resilience Research Centre, 2014; Mansfield et al., 2014; Sammons et al., 2007, p. 694). Henderson and Milstein (2003) in their study defines a resilient teacher as one who gives of self in service to others and/or a cause, uses life skills, including good decision making, assertiveness, impulse control, and problem solving, and one who has the ability to be a friend, ability to form positive relationships, sense of humor, self-discipline, independence, positive view of personal future, flexibility, capacity for and connection to learning, personal competence (is good at something), self-motivation, and feelings of self-worth and self-confidence.

Earlier studies revealed that resilience developed through the rebounding qualities of self-esteem, self-efficacy, and support systems (Richardson, 2002). Day and Gu, (2007) view resilience as the ability to withstand difficulty and bounce back. Teachers with characteristics of resiliency are far more likely to persevere in adverse situations, they are far less likely to consider quitting the profession, and find it easier to adapt to change. This study therefore, attempts to add to the literature by providing empirical evidence on teacher resilience and examining beliefs, and perceptions of teachers with the aim of building a supportive professional development settings conducive for technology inclusion to make both teaching and learning more effortless. The study in doing so takes on the views of five teachers at different stages of their careers to explore the interaction between teachers’ professional and personal identities and their management of these interaction which they experiences in each professional life phase. Teachers’ capacity to manage such interplay is a challenging process which contributes strongly to the relative strength of their resilience in ICT emerging trends. Studies have revealed a range of challenges that may constrain teacher resilience in the classrooms (Beltman, Mansfield & Harris, 2016). Teachers may need to cater for students with difficult behaviour or individual learning needs, schools in low socio-economic status (SES) areas can be demanding and difficult to staff due to the presence of students with behavioural problems, low achievement, and multilingual backgrounds (Castro, Kelly, & Shih, 2010). Schools located in disadvantaged areas with limited resources and ICT facilities also add to the challenge. These challenges may force teachers in areas of low SES to stay on as teachers for a short period of time and such schools are likely to employ untrained teachers as staff members (Riddell, 2013). Unsupportive school leaders or lack of resources, problematic relationships with students’ and parents, heavy workloads and externally imposed regulations from school boards can also be a challenge (Ebersohn, 2012; Beltman et al., 2016).

3. Methods

To allow for a detailed examination of the relationship and interaction between teachers’ professional, personal identities and relative strength of their resilience in technology emerging trends, the author used a case study approach (Yin, 2009). The research questions required participants who were interested in making changes in their professional development and were willing to share and be open in speaking about both positive and negative experiences related to their teaching experience. Because such experiences might be difficult to talk about with a stranger, the author recruited participating teachers who had previous working relationship with the author in a professional development institute. Three out of five of the teachers, referred to in this paper as Stella, Julie and Sly, agreed to participate and speak freely. All teachers allowed me to inquire extensively into their experiences as they tried to enact changes, sharing their successes and their challenges and continuous struggles as teaching becomes redirected towards ICT integration. As such, these cases provided a suitable context for investigating the aforesaid research questions which also includes whether experiences played any role in these struggles. I see the case selection criteria as similar to that described by Lloyd (2008), whose case study subject was chosen “in light of his willingness to share his experiences, on one hand, and the interesting qualities of his experiences, on the other” (p. 167).
Semi-structured interview protocols were designed based on the research questions and participants’ stage in the teaching. Two paired (Evens & Houssart, 2007) and two individual interviews were administered and were also audio-taped. Core questions were pre-developed to explore participants’ perceptions and probes were used based on their answers. Pre-developed interview questions were guided by the main research questions, and sample interview questions included “How do you describe yourself as a teacher?” and “How do you view ICT as a tool in teaching?” The interviews were conducted over the course of a semester. Conducting the paired interview was like conducting a focus group interview, Julie and Sly were paired as they are in the same department. This was also to elicit more open and candid responses (Hatch, 2010). In such situations the participants assume a level of control in the conversation that will allow a good flexibility in the direction of the interview (Byers & Wilcox, 1991). The interview allowed the teachers to evaluate themselves and sort strategies they planned to follow in the integration of ICT in teaching and learning.

3.1. Participants

Stella, Julie and Sly, teach at the same teacher college in a suburban area near a state capital in the south part of Nigeria and also graduated from the same university in the city. Julie has 10 full years of teaching experience, while Stella and Sly have taught for eight years. The school enrolled approximately 2000 students in the first year level and has more females (65%) than male student population (35%). About 5% of students in the school have learning disabilities. All teachers have courses they have taught repeatedly over each school year as this has become a method for improving teaching practice and resilience.

4. Findings and Discussion

In this research two major issues stood out for the teachers. Firstly, teachers responded positively to reforms, because they believed that the very nature of the reform and their professional development places them on the path of success of technology integration. Even as studies suggest teachers interpret reforms to mean that their current performance is unsatisfactory and thus needs to be modified in order to increase achievement levels as they are ineffective in their jobs (Cross & Hong, 2009). Sly considers himself to be a successful teacher and the teaching profession quite rewarding. He responded quite favorably when asked about ICT integration in his class, but has his reservation of “its practicality, it can’t work with my class size,…this talk has been around for a while, too many reforms all in paperwork, it will be best for everybody, me, students, other teachers if they come to terms with how technology will be placed in the class, I sometimes think this people are not serious”. Sly considers himself as having good pedagogical skills and associates his student’s success with his skills. These skills, from his point of view he developed through professional training which included reform-based practices associated with science teaching and ICT devices, he has not used and has to improvise, he perceives the reform clamour from outside of the school community to mean that he was not an competent teacher, an assessment that poses a threat to both his teacher identity and efficacy and so elicited unpleasant feelings for a situation he didn’t cause. He wasn’t taught in his school days with ICT tools but accepted the new learning approach. He concludes “I am very frustrated and just angry with the whole process, I want to give my best but in the present circumstance what do I do?” When teachers experience unpleasant emotions in the process of implementing their classroom goals, the result may be emotion-induced action or inaction, feelings of frustration may lead teachers to be less creative and innovative in seeking solutions and developing alternative teaching strategies to meet the goal (Cross & Hong, 2009). It is believed that education managers and administrators can also enable teacher resilience in a number of ways. By taking up this critical role they can support teacher through developing collaborative and supportive school communities, teachers need recognition and affirmation (Day & Gu, 2014). Hong, (2012) posit that such communities can have a positive impact on teachers’ efficacy and job satisfaction. Administrators can enable teachers to exercise autonomy, teachers’ enthusiasm and persistence improve (Taylor, 2013). To facilitate the development of resilience ‘that is essential if teachers are to thrive in the profession’ (Buchanan, Prescott, Schuck, Aubusson,
& Burke, 2013, p. 126). Building positive relationships with teaching colleagues and both formal and informal mentors can also support teachers (Cameron & Lovett, 2015).

Dahiya (2004) views teaching as a social phenomenon, involving a series of actions, actions held together and formed to uplift an individual by enabling him/her to acquire knowledge, skills, and attitudes. Teaching is a profession or service of a community or group of individuals known as teachers. Maphalala, (2014) stresses various professional components like competence, professional motivation, work stress, accessibility, dedication, enthusiasm, professional conduct, as greatly influencing the teaching profession. The second issue in the findings was teacher identity formation, answering the question how do you view yourself as a teacher? For Stella and Julie, both did not set out to be teachers but found themselves in the profession out of “nothing else to do”, and had no prior professional training as teachers. Questioning her choice of career, Julie responded, “I think I am a lot more secured now. She tells how, initially arriving home each day, I felt so tired and dejected. I will ask myself “how did I end up with this job?” and “do I really want to do be a teacher?” she says, “I felt hopeless.” Stella’s challenge is on focusing and embracing the job, “I have had a lot of thoughts about whether the teaching profession suits me eight years on and I am still not sure I want to be here”. In the midst of identity conflicts, Stella is concerned about performing her teacher duties in the way that she wants to. It may appear as though her lack of interest in the profession has little to do with the ICT integration and classroom practice. But Stella says, ‘I tried desperately to focus on my course preparation because I did not want my work performance to decline in any way due to me’. “I am struggling to hold it in”, “Then I have to work with technology and the training is so tasking”.

The interview has revealed a lot about Stella’s identity experiences of becoming a teacher. Ms. Stella has still not recognized herself as a teacher in her terms even though this is the identity that she tries to maintain while in and out of the school. In line with Carter and Doyle (1996) who suggest that “the process of learning to teach, the act of teaching and teachers’ experiences and choices are deeply personal matters inexorably linked to their identity and life story” (p. 120). They further suggest that becoming a teacher means (a) transforming an identity, (b) adapting personal understandings and ideals to institutional realities, and (c) deciding how to express one’s self in classroom activity” (p. 139). Individuals who bring themselves into the classroom have to become aware of and understand their professional identities because doing so has implications for their practice (Farrell, 2015).

5. Conclusion

The insights generated by this study have wider implications for teacher professional development. The present study fills an important gap by focusing on identities that are articulated in interpersonal dialogue and which reveal personal transformations of individuals for technology integration. For the participants it is a shift from who they were onto who they have to be, building and developing an identity of self and societal expectations, working under set regulations and conformity, also revealing how experiences of being a teacher and the emotions connected with such experiences can easily change. Findings from Buchanan et al., 2013 have demonstrated the importance of reflection, responsiveness and resourcefulness for teacher retention, in 21st century classroom. The development of skills for ICT integration and handling of identity experiences can have a similarly positive effect.

In Henry’s (2016) view, when individual teachers ask personal questions such that will allow them make connections between who they are and what they do in their classrooms, schools, and beyond, then may be it would not be a destabilizing and emotionally charged experience, but a focus of building a professional identity alongside emerging new technology in teaching and learning.

5.1. Limitation

This study is limited by a small sample size and single point of data collection. A study of five teacher’s identity transformations is not a representation in views of teachers in the whole country,
or other individuals in other settings. Therefore, if the insights generated by the study are to be of wider value in teacher identity and ICT integration, further case study research is required.

References


Transfer of Ownership: Designing for Scholarship of Learning and Teaching

Jayakrishnan WARRIEM *, Sahana MURTHY * & Sridhar IYER *

*IDP in Educational Technology, IIT Bombay, India
*jayakrishnan.m@iitb.ac.in

Abstract: Teachers engaged in higher levels of Scholarship of Learning and Teaching (SoLT) is associated with better teaching-learning outcomes. Variety of strategies, like seminars, conferences, trainings etc. is used for elevating teachers to engage in higher levels of SoLT. In this paper, we extend the design principle of “Transfer of Ownership”, available in development research literature, to design teacher professional development (TPD) programmes to target SoLT among in-service teachers. We explain how this design principle was used in implementation of a blended TPD for technology integration among a group of 53 engineering college teachers. At the end of the training, 9 of the teachers who were most engaged in the training had successfully taken ownership of the problem of effective technology integration in their own classroom and had devised action research studies to further investigate it. The results opens up avenues for us in exploring ways of operationalizing “Transfer of Ownership” across multiple modes and scales of TPD implementation.

Keywords: Scholarship of Learning and Teaching, Transfer of Ownership, Teacher Professional Development, Technology Integration

1. Introduction

Scholarship of Learning and Teaching (SoLT) movement encourages teachers to perform inquiry on students’ learning and further disseminate their findings through peer-reviewed academic publications (Boshier & Huang, 2008). Adoptions of SoLT practices have shown evidences of faculty contribution to the knowledge in their individual discipline (Healey, 2000) and generation of sustainable teaching-learning practices within an institution (Richlin & Cox, 2004). With the ubiquitous use of technology in teaching-learning practices now, promotion of SoLT around teacher professional development (TPD) practices gains currency and relevance (Hutchings, Huber & Ciccone, 2011). The existing conceptual models of SoLT (Trigwell & Shale, 2004, Kreber and Cranton, 2000; Trigwell et. al., 2000) provide additional guidance in the aspects to be considered while designing and implementing such TPD activities. However the challenge lies in, i) facilitating the participants to rethink and refine their current practices, and ii) further scaffolding them in the process of inquiry on students’ learning due to the refined practice (Kreber & Kanuka, 2006).

An initial effort of the authors targeting SoLT practices through a TPD programme had shown encouraging results. In addition to statistically significant learning gains in educational research methods, 9 participants had successfully disseminated their action research experiences in a peer reviewed international conference (Warriem, Murthy & Iyer, 2013). However, a major challenge that we faced during this effort was that most of the teachers in our operating context didn’t have any formal pedagogical training (National Knowledge Commission, 2009). This made it hard for them to learn and engage with the SoLT practices. To overcome this challenge, we had designed and implemented two large-scale training programmes that focused on introducing research-based student-centered pedagogy (Murthy, Iyer and Warriem, 2015). These efforts had introduced the design principles of “Immersivity” and “Pertinency” for design and implementation of TPD programmes (Warriem, Murthy & Iyer, 2015). These principles were found to have a visible impact on teachers’ awareness of their teaching-learning practices and its effect on students’ learning, which is a desirable starting point to engage in SoLT practices. In this paper,
we present an extended TPD effort to engage teachers in further SoLT practices by adapting the design principle of “Transfer of Ownership”.

We have adapted the idea of transfer of ownership from the works of Honkalaskar et. al. (2014) and Chambers (2007), that identifies peoples’ involvement, their sense of ownership and control to be crucial in sustainability and spread of interventions, while being done by an external agency. We have extended this idea to the context of teacher professional development (TPD) by identifying Transfer of Ownership as the planned action of shifting the focus of TPD from the trainer’s goal of improving teaching-learning practice to the participants’ involvement and control to engage in effective teaching-learning practices. In our TPD program we apply transfer of ownership to design relevant activities and corresponding scaffolds for participants. We first provide teachers with scaffolds to elicit ideas for solving their teaching-learning problems. Then these teachers are provided with training on educational research methods that they can use to conduct systematic inquiry on the implementation of these ideas. This design principle thus helps in design of TPDs that reflect a “narrative of growth”, emphasizing the agency and desire of the participating teacher in their own professional development (O’Meara, Terosky & Neumann, 2008) and resulting in improvement of student learning. The narrative of growth is known to have alignment with the key ideas in SoLT practices (Kong, Lai and Wong, 2017).

In the current work, we explain design and implementation a teacher professional development programme for engineering educators in India in blended mode. The focus of this training was to train teachers in action research and disseminate their action research findings. Results at the end of the training showed that participants had taken up the ownership of the teaching-learning problem within their classrooms and devised study plans to perform an inquiry on their practice.

2. Related Work

2.1. Evolution of Scholarship of Learning and Teaching (SoLT)

Boyer (1990) initially proposed the idea of “Scholarship of Teaching”, where he identified teaching as a “highest form of understanding” that can be further taken up for scholarly research work (Vardi, 2011). This was further refined to differentiate it from excellent teaching, by clarifying the need for teachers engaged in “Scholarship of Teaching and Learning” to systematically investigate questions related to students’ learning (Hutchings & Schulman, 1999). McKinney (2006) further expanded the teaching practice to include three levels: i) good teaching, which looks at performance of the teacher, ii) scholarly teaching, which requires teachers to reflect and refine their practice and iii) scholarship of teaching and learning, that advances the knowledge on teaching-learning issues by making it available for public review. Thus teachers engaged in SoTL typically poses questions about their own practice, tries to collect evidence, analyze and interpret the results, take informed action on the findings and finally document and disseminate both the process and outcomes (Connolly et. al., 2007). Though evidences are collected on student learning, SoTL was criticized for both its focus on the formal classroom practice that stresses teaching more than learning (Boshier and Huang, 2008) and the ambiguities involved in the operationalization of SoTL (Boshier, 2009). Scholarship of Learning and Teaching (SoLT) was thus proposed for the practice to emphasize the paradigm shift to learning from teaching (Boshier and Huang, 2008).

2.2. Models of SoLT

There exist several conceptual models that provide us guidelines on the processes involved in engaging teachers in SoLT practices. Trigwell et. al. (2000) had proposed a model that consisted of four dimensions – Informed dimension, Reflection dimension, Communication dimension and Conception dimension, that tries to explain the engagement of teacher in the process of SoLT. The informed dimension measures the extent to which a teacher engages in scholarly contributions of others (research literature) while the conception dimension measures the extent of the teacher’s focus on the teaching practice as against that on student learning. The reflection dimension
measures the extent of reflection and can vary from an unfocused approach to a very focused approach aimed at increasing the teacher’s present understanding of the teaching-learning process. The communication dimension refers to the extent to which the teacher engages in dissemination of their findings and can vary from absence of dissemination to publication in international journals. Kreber and Canton (2000) had developed their model on the basis of types of reflection possible across three domains of knowledge about teaching – Instructional knowledge, Pedagogical Knowledge and Curricular Knowledge. Three types of reflections were found to be possible in each of the dimension viz. Content reflection, Process reflection and Premise reflection. Thus a total of 9 elements were present in this model.

With teaching academies being created to support SoLT, Schulman (2004) had proposed four models that involved different roles played by teaching academies in promoting SoLT practices. These models considered teaching academy as – An interdisciplinary center, an aspect of graduate education, organized around technology and distributed teaching academy. A practice-oriented model also was available that looked into the dimensions of knowledge, practice and outcome to explain achievement of SoLT (Trigwell & Shale, 2004). While the knowledge included the various dimensions of domain, pedagogy and context, outcomes included elements like student learning, documentation, teacher learning and teacher satisfaction. The dimension of practice acts as a bridge between knowledge and outcome and included elements of teaching, evaluation, reflection, communication and learning.

A common feature that can be seen in all models, except Schulman’s institutional model, is the focus on teacher’s internal processes and the ways in which these could be measured.

2.3.  Teacher Professional Development and SoLT

The relevance of SoLT for teacher professional development has further increased due to the ubiquitous presence of technology within teaching-learning (Hutchings, Huber and Ciccone, 2011), as the impact of technology on student-learning can be carefully examined and understood by the teacher themself. Numerous TPD activities like seminars, pedagogical courses, campus conferences on learning and teaching and reward programmes are available for engaging faculty in SoLT. Engaging teachers in a community of practice is yet another PD activity that is found to greatly avoid issues related to isolation, stress and marginalization among teachers participating in an SoLT community (Martensson, Roxa & Olsson, 2011).

2.4.  Positioning of our work

SoLT based professional development is being criticized due to a lack of clarity involved in the exact activities and outputs expected from the faculty (Brew, 2007). The current models for promoting SoTL inform us of different dimensions across which the change has to occur within the participating teachers. However the TPD designer faces the challenge of i) facilitating the participants to rethink and refine their current practices, and ii) further scaffolding them in the process of inquiry on students’ learning due to the refined practice (Kreber & Kanuka, 2006). The current work tries to address this gap by providing a design principle and an instance of its operationalization that will benefit TPD designers.

3.  Background

Before the current study, we had designed and implemented two large-scale blended training programmes focusing on introducing research-based student-centered pedagogy while integrating technology in classroom (Murthy, Iyer and Warriem, 2015). Participants were trained in student-centered pedagogies like Think-Pair-Share and Peer Instruction and also in effective use of technologies like Wiki, Screencast and Visualizations. These trainings were designed and developed using the design principles of “Immersivity” and “Pertinency”.

“Immersivity” is defined as the feature of the learning environment that drives participants to be involved in a set of meaningful activities (Howland et. al., 2012) and to get cognitively engaged in the content (Sherman & Craig, 2003). Immersivity is built upon the need for having
active learning within the training environment (Desmione, 2009) by adding the concept of immersion (Calleja, 2007), prevalent in the virtual reality and gaming literature. “Pertinency” of teacher training content is defined as the training participant’s perception of degree to which the given content is applicable for his/her teaching immediately after the training. This idea builds upon the element of job relevance (Venkatesh & Davis, 2000) by adding the constraint of immediate practice.

4. Transfer of Ownership

Transfer of Ownership is defined as the planned action of shifting the focus of TPD from the trainer’s goal of improving practice to the participants’ realization of the need to improve practice, by trying to solve teaching-learning problems within the context of the participant. This principle has been adapted from the development literature dealing with participative research methodologies. Development literature identifies peoples’ involvement, their sense of ownership and control to be crucial elements in sustainability and spread of interventions (Honkalaskar et. al., 2014; Chambers, 2007). Thus a participative development process would have ensured the transfer of ownership from development agency to the intended beneficiaries by engaging them in the problem and solution identification process (Honkalaskar et. al., 2014). The “Transfer of Ownership” was implemented explicitly by training the participants in performing classroom action research (CAR). CAR allows teachers to carry out systematic inquiry in their own practice and enable them to improve their understanding of the pedagogy and thereby improve student performances (Norton, 2009). Within the broad continuum of action research, CAR method fits between personal reflections and formal educational research (Mettetal, 2012). Apart from the reported student benefits and institutional benefits, CAR is known to have benefits of greater sustainability and empowerment among the teachers (Bradshaw et. al, 2014).

4.1. Implementing Transfer of Ownership

The seven-step process of CAR identified by Mettetal (2012) has been adapted as three separate phases within our design (see Figure 1 below). These three phases are: Idea Proposal Phase, Study Planning Phase and Study Implementation Phase. In this paper, we focus on the first two phases to explain the implementation of Transfer of Ownership.

- In the Idea Proposal phase, participants first identify a teaching-learning problem within their own context. This is followed by a preliminary literature review (3-4 research papers) to justify the need to solve problem and identify existing solutions. Once the problem has been sufficiently motivated, they proceed to proposing their own solution, based on the technology integration practices learnt during training.
• In the *Study Planning phase*, participants will refine their problem/solution through a detailed literature review. The framing of the research questions and detailing of the research method follow this, leading to a plan for the study.

The entire process of Idea Proposal and Study Planning is iterative and participants may have to perform several iterations to refine their solution idea and research study plan. Hence these stages are shown as loops in the figure.

4.2. Scaffolds for assisting in inquiry

To scaffold the participants in this process, they are provided with two scaffolds – Idea Planning Template and Study Planning template (Murthy & Iyer, 2013). These templates contain both guiding questions and example answers to help the participants reflect on their intended practice and identify ways to systematically perform inquiry on student learning. For example, in figure 2 below, we see a sample question from the idea planning template, which elicits proposed solution by the participant, along with an example solution idea. As seen in the figure, the main guiding question contain further probes that help participants to reflect on both their intended practice and its impact on student learning.

![Figure 2](image)

Figure 2. An example question from Idea Proposal Template with a sample answer

5. The TPD Programme

The current training programme started a semester after the end of the training programme discussed in section 3 above. 53 members, who participated in one of the earlier training programmes, volunteered for participating in this training. Participants were provided training in a new technology – Padlet™. The training utilized the technology platforms of MOODLE, Wikispaces and Padlet. There were two phases of training – (i) An asynchronous online training, equivalent to an instruction time of 1.5 weeks, started in June and ended in October, 2015 and (ii) A face-to-face training in classroom action research training, which lasted for 3 days, during the final week of October (October 23-25, 2015). In the asynchronous phase, participants engaged in reflection about their practices in the wiki, engaged in discussion with other participants through MOODLE and Padlet and had designed lesson plans to integrate Padlet within their teaching-learning practice. Apart from the design principle of “Transfer of Ownership”, this training had used “Immersivity” and “Pertinency” to ensure participants’ engagement during the training. In the face-to-face sessions participants were provided with training on educational research design and had to submit an Idea Proposal and a Study Planning Assignments that they plan to take up after the training. These participants used the course wiki (MEET2k15, 2015) to detail out these assignments. At the end of the training, the participants presented their study and observed feedback from both peers and the trainers.
6. Evaluation

This is part of a longitudinal study and at the time of reporting, two years since the training programme has transpired. We now explain the methodology used for evaluation of the training programme. Since there are multiple aspects that needed to be investigated, mixed-methods were adopted for the evaluation. The research question that guided our evaluation was – “What changes were observed in the ownership of problem during the training for engaging participants in SoLT practices?”

6.1. Sample and Data Collection

We analyzed the artefacts created by the 9 participants, who submitted both the idea proposal and study planning assignment. The study had multiple qualitative data sources to evaluate the effect of training on participants, and we primarily relied on content analysis. Table below shows the various data sources, instruments and the methods that we have used for data collection and analysis.

Table 2: Data Collection and Analysis Methods

<table>
<thead>
<tr>
<th>Focus of Investigation</th>
<th>Data Source</th>
<th>Instrument Used</th>
<th>Procedure for data collection</th>
<th>Data Analysis Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inquiry in TL practice</td>
<td>Idea Proposal Assignments</td>
<td></td>
<td>Idea proposals written in Wiki</td>
<td>Content Analysis</td>
</tr>
<tr>
<td></td>
<td>Study Planning Assignment</td>
<td></td>
<td>Study Plans written in Wiki</td>
<td></td>
</tr>
<tr>
<td>Reflection about the training programme</td>
<td>Focus Group Discussions</td>
<td>Semi-structured questions</td>
<td>Recording and Transcribing discussion.</td>
<td></td>
</tr>
</tbody>
</table>

7. Results

We are still in the process of content analysis and in the results we show our preliminary findings.

- Participants explicitly applied the technology and pedagogic practices that they learnt in the TPD to create proposals to improve student learning in their classroom
  Nine participants had submitted a research idea during the idea proposal stage. On closer examination of these idea proposals it was observed that all the participants have made use of either the strategy or technology that they were trained in. Four participant ideas utilized technology of Visualizations, two utilized Padlet and one used Wiki. Three of the ideas utilized the strategy of Think-Pair-Share while one study utilized Peer Instruction for effective technology integration. An example of ideas was “Use of Padlet and TPS in a flipped classroom strategy to engage participants in discussions within the topic of CPU Scheduling”.

- Participants perceive that the TPD activities designed on the basis of Immersivity have resulted in their being able to design effective learning activities for their own students
  The focus group discussion highlighted the effect of design principle of immersivity and transfer of ownership has led to significant positive effects in participants’ own practice. Comments like “while introducing a new tool to us, in the pedagogy workshop [Initial trainings], Wikispaces, they [Researchers] have treated us as a learner” and “Because of the training what we have experienced here [Initial trainings and Asynchronous part of the current training], the same level of training we are followed in our classroom to create a familiarity of the tool. Now the students are asking whether we can use wikispace or some other tool for our course” indicate how the learner-centered designs (for Immersivity) led to positive practices and experiences.

- Participants reported that their students show higher interest and engagement when they used technology-based learner centred strategies learnt in the TPD
The focus group discussions shed light on evidence of positive student attitudes and behaviours when participants devised more learner-centered strategies using technology. The participants also indicated how the students, taking examples of specific tools that they were trained in, appreciated their technology integration practices. E.g. the comment by a participant “the students are so much interested whenever the staff [the participant] comes to class. [The students say that] we will be using wikispace, so we will be posting materials there, we will be getting materials, we will be doing activities there, mini projects in a team work. So they [students] have too much interest to work with the tool [wikispaces]” indicates how ownership of technology integration practices are being taken up actively by teachers.

- Participants plan action research to sustain inquiry practices post training

Participants created the idea proposal and study planning assignments to solve problems related to student learning within their own practice. Comments like ‘[the workshop] is promoting us to be an Educational Researcher. We have learnt these things [about planning the research], now we need to practice’ indicated that participants had intention to follow-up and sustain the inquiry practices that they were trained in. The engagement in the workshop has also led the participants to think of more action research studies as is evident from the comment ‘Actually we have taken 3-4 ideas with us [after this training]. So it is 3-4 [study] templates we can independently plan.’

8. Discussion and Conclusion

The above results indicate that the TPD training has helped participants to refine their practice. Taking their role as action researcher further, participants prepared detailed action research study plans to evaluate their students’ learning. Finally, participants have intention to apply technology integration strategies beyond what they learnt the TPD, and have planned further studies. To address our RQ, “What changes were observed in the ownership of problem during the training for engaging participants in SoLT practices?”, we see that the training helped in transfer of ownership of the problem from the trainer to the participant teacher and they have engaged in higher levels of SoLT.

Two months post the training; two of the participants had presented four action research studies in a peer reviewed international conference. These studies were co-authored with 9 other colleagues from their institution, who were among the participants of initial pedagogy training (described in 4.1). Three of these papers dealt with classroom teaching-learning experiences (Mistry, Halkude and Awasekar, 2016; Indi, Yalagi and Nirgude, 2016; Yalagi, Indi, and Nirgude, 2016) and one paper dealt with the working of professional learning community developed in an institution based on the various student-centered practices detailed in the pedagogy training (Halkude et. al., 2016). Together these results can be interpreted as teachers taking both ownership and leadership roles in solving the teaching-learning problems within their own context.

A limitation of this study is that we have not reported the analysis of evaluation of the idea and study plans to provide insights on the quality of the inquiry practices reported. This is planned as a future work, as the current effort primarily looked at the evaluation of the training. Another limitation is that we have not explored the specific reasons for high attrition (only 9 out of 53 attending face-to-face training) within the training itself. Being a voluntary effort, we suspect that contextual factors like timing of the workshop (mid-semester) and academic load would have had a greater bearing on participation rates.

In this paper, we describe the implementation and evaluation of TPD aimed at engaging teachers in SoLT practices. The design principle of “Transfer of Ownership” was utilized in the TPD design to achieve this aim. It is seen that over the course of training, participants shift their focus from effective use of technology to sustain inquiry practices about student learning. Thus transfer of ownership can be regarded as a potential means to progress towards higher levels of scholarship of learning and teaching. Further work can focus on how TPDs can be designed to incorporate transfer of ownership as the basis of the TPD activities right from the start.
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References


An Investigation of Collaborative Ubiquitous Learning in Promoting Socio-Cultural Knowledge and Skills in 21st Century: Integrating History, Geography, Architecture, Science and Culture Study

Chitphon YACHULAWETKUNAKORN\textsuperscript{a,b}, Ratthakarn Na PHATTHALUNG\textsuperscript{b}, Jintana WONGTA\textsuperscript{c} & Charoenchai WONGWATKIT\textsuperscript{d}\textsuperscript{*}

\textsuperscript{a,b,c}Engineering Science Classroom, King Mongkut’s University of Technology Thonburi, Thailand
\textsuperscript{d}Department of Computer and Information Technology, Faculty of Industrial Education and Technology, King Mongkut’s University of Technology Thonburi, Thailand

*wongwatkit.c@gmail.com

Abstract: This paper attempts to investigate the effects of the collaborative ubiquitous learning approach in promoting socio-cultural knowledge. The content used in this study was associated with history, geography, architecture, science and culture study of the Rattanakosin period; moreover, these chronological events were represented in a story timeline. Besides, the learning activities were designed to support such learning environment and incorporating 21st-century skills. These processes required students’ efforts to work in groups to experience the actual sites on a field trip in order to inquire the socio-cultural knowledge. The students received and responded to the missions on their mobile devices. After the actual implementation of the proposed learning method, it was found that the students could reach the high level of the learning achievements from the proposed learning activities, implying that they could apply the integrated knowledge of several subjects to form the historical story. Furthermore, the high-achieving students could perform more advanced 21st-century skills than the other groups on their works. Moreover, the finding of this study could bring more applications of ubiquitous learning to promote integrated learning contents with collaborative knowledge construction.

Keywords: Story-based learning, ubiquitous learning, social study, 21st century skills, constructionism, collaborative knowledge construction

1. Introduction

Nowadays, story-based learning is considered as the interesting concept for teaching and learning which many educational institutes popularized to use this concept as the main concept for learning, especially the curriculum that collaborates each science area in order to discuss in the form of knowledge story. For the concept of story-based learning applied, the subject is set as the core’s inevitably be History. Generally, History is a part of Social studies. Social studies are the integrated study of the social sciences, humanities, and history. Within the school program, social studies provides coordinated, systematic study drawing upon such disciplines as anthropology, archaeology, economics, geography, history, jurisprudence, philosophy, political science, psychology, religion, and sociology, as well as appropriate content from the humanities, mathematics, and natural sciences (Story-Based learning, 2016). In addition to learning memorization, students could discuss their knowledge not only in the form of memorization but also in the form of critical thinking. Hence, history is considered as science that suited to be the core science which collaborates other subjects in the form of story-based learning.

For the social studies situation of existing learning, the form of teaching mostly based on the lecture, especially in the classroom which students quietly attended in class. Due to lecturing in
class, teacher normally encouraged students to participate in the classroom. For instance, the teacher encouraged students to analyze the historical incident by persuading them to explain the historical result, while lecturing, students could freely use a mobile phone for searching data that they want. From the classroom’s situation mentioned, teacher attempted to inject the systematic thinking, the cognitive process of studying and understanding systems of every kind. Nevertheless, in this present class, learning is not enough for skills needed in the 21st century era; therefore, the self-learning using the device in the form of the field trip is necessary to consort with the skill of learning and innovation skill, and digital literacy skill too. In addition to regular classroom, a field trip is another form of learning that support that students to participate with place, people, and environment (DeWitt & Storksdieck, 2008).

Even though mobile learning’s not considered as the newest form of learning but it was popularized among students. Owing to it’s convenient to search any data from Website, mobile learning was gradually an important role in education inevitably. In the past decade, teachers gradually change from the lecture-based learning to mobile learning through the mission that allocated to each group instead of lecturing from the lecturing even in the field trip. From the field trip using device, most students reacted feedback positively in many aspects. Nevertheless, mobile learning in field is still be advantage as following: First, it is convenient to search data from many credible website. Second, it is an active learning so students can participate with the real context. Last, it is an opportunity for students to think and analyze data online in order that they could segregate both unbelievable and credible data from Internet and others channel (Laru, Järvelä, & Clariana, 2012).

Skills needed in 21st Century is considered as the renounced latest trend of education and human resource’s performance in nowadays. Its objectives aim to construct students and personnel to be accepted not only in workplace, but also enjoyably live in 21st Century (Pellegrino & Hilton, 2012). Hence, skills needed in 21st Century considered as a significant concept for develop students and personnel in the present and future time. Students could collaborate knowledge in the term of interdisciplinary. For example, Communication skill used in the interview’s mission because students had to interview peoples in the field, such as, guide, monk or even tourist. Collaboration skill normally used in every mission because it’s group work. Creativity skill also used in ordered to make Video clip, and drawing. For the critical thinking skill, all students used this skill in every question inevitably.

According to the phenomenon of learning social studies, therefore, the collaborative ubiquitous learning is adopted as an efficient learning form in this study, called CULS. The concept of CULS encouraged students to be active learners more than the old field trip because all students mostly participated in their own groups. They were assigned any tasks to every member. So peer anticipated them to do their task as good as possible. In addition to the advantage of CULS, the activities that assigned to students were greatly developed for learning efficiency. Moreover, these developed activities help students to promote the socio-cultural knowledge and skills in 21st Century by integrating certain stories from History, Geography, Architecture, Science and Culture Study.

2. Related Study

2.1. Ubiquitous Learning and Social Study

Ubiquitous learning is considered to be both pervasive and persistent, allowing students to access education conveniently, calmly and seamlessly. Ubiquitous learning has the potential to revolutionize education and remove many of the physical constraints of traditional learning (Yahya, Ahmad, 2010). Moreover, the integration of adaptive learning with ubiquitous computing and u-learning may offer great innovation in the delivery of education, allowing for personalization and customization to students needs. According to Ogata and Yano (2004), there are six essential components of ubiquitous learning are the following: First is Permanency: Learners never lose their work unless it is purposefully deleted. In addition, all the learning processes are recorded continuously every day. Second is Accessibility: Learners have access to their documents, data, or videos from anywhere. That information is provided based on their
requests. Therefore, the learning involved is self-directed. The third is Immediacy: Wherever learners are, they can get any information immediately. Thus, learners can solve problems quickly. Otherwise, the learner can record the questions and look for the answer later. Fourth is Interactivity: Learners can interact with experts, teachers, or peers in the form of synchronous or asynchronous communication. Hence, the experts are more reachable, and the knowledge becomes more available. Fifth is Situating of instructional activities: The learning could be embedded in our daily life. The problems encountered as well as the knowledge required are all presented in their natural and authentic forms. This helps learners notice the features of problem situations that make particular actions relevant, and the last is Adaptability: Learners can get the right information at the right place with the right way.

There are many research studies on ubiquitous learning in the past decade. Hwang, Hung, Chen, and Liu (2014) developed an advanced ubiquitous learning to develop students' competent in field ubiquitous learning. Shih, Kuo, and Liu (2012) found that the u-learning model is conductive to the improvement of students’ mathematics achievements. For others, u-learning aspect, Hung (2016) have attempted to develop learning environments that combine real-world contexts and digital-world resources to provide students with direct experiences of the real world with sufficient learning support. Wu, Hwang, and Tsai (2013) also supported the idea that context-aware ubiquitous learning is such an approach that enables students to learn from the real world with support from the learning system using technologies. Finally, ubiquitous learning is quietly effective to improve and also enhance learning skill both in the context of the real world and digital world.

Ubiquitous learning rapidly popularized among education’s sector. Social studies are considered as the subject that slightly changes comparing with science because it recognized as the knowledge that students learned from the historical period, politics, social, and economical change. So the social studies theory’s quietly certain. Applying ubiquitous learning to social studies class is necessary for students to oppose to any opportunity to exchange and construct knowledge (Hover, Berson, Bolick, & Swan, 2004). Moreover, u-learning could also become a means for micro-managing school districts, teachers, students, and curricula too. In addition, ubiquitous learning had an important role to develop social studies curriculum which affects each sector which involves with social studies curriculum construction realize the effect of ubiquitous learning in the future.

2.2. The 21st Century Skills

21st-century skills are the form of higher-order skills, abilities, and learning dispositions that have been identified as being required for success in 21st-century society and workplaces by educators, business leaders, academics, and governmental agencies. According to rapidly change phenomenon, many sectors realized that there are skills required for students to master in preparation for success in the 21st century. Hence, many of these skills are also associated with deeper learning, which is based on mastering skills such as analytic reasoning, complex problem solving, and teamwork (Pellegrino & Hilton, 2012).

Nowadays, many educational institutes widely adapted their curriculum and teacher professional development in order to consort with 21st-century skill. According to Bell (2010), the teacher encouraged students to construct knowledge in the form of the project-based learning; as a result, students could increase the critical thinking and collaboration skill as they engage in the project. In addition, problem-based learning (PBL) was another concept learning for a 21st-century skill that students should concern. Gwee (2009) applied PBL as learning system design for the education of healthcare by taking the demonstrative situation in class. In this case, the problem is considered as a stimulus for learning. Thus PBL can contribute to the improvement.

To be a good learner and staff in the 21st Century, technology is considered as a significant tool that enhances skill need in this century inevitably. Mobile-learning is another concept of education that everyone should concern, especially in social studies subject, using mobile technology attracted students participate in learning. Charitonos (2011) studied the potential of social and mobile technologies to support and enhance visitor’s learning experience in museum, the result showed social and mobile technologies have an impact on the social dynamics; it is anchored in sociocultural perspectives of learning as meaning-making, with a focus on mediating
artefacts in the development of understanding. Like Shih, Chuang, and Hwang (2010), mobile-learning was the learning’s concept that be effective in the field trip.

Therefore, applying m-learning in social studies’ field is so necessary that educational institute should adapt this concept in their curriculum because it’s not only increase learning performance, but also popularized among learner too.

2.3. Interdisciplinary Learning and Collaborative Knowledge Construction

Interdisciplinary learning is the integrating of multidisciplinary knowledge across a central program theme which helps learners to develop more advanced epistemological beliefs, improved critical thinking and metacognitive skills, and an understanding of the relevant among perspectives derived from various disciplines (Ivanitskaya, Clark, Montgomery, & Primeau, 2002). Moreover, the Interdisciplinary study is a process of answering a question, solving a problem, or addressing a topic that is a single discipline could not be dealt with because of its’ complexity, and the goal of integrating the learner’s insights to construct a more deep understanding of knowledge (Repko, 2008).

Nowadays, many research studies try to implement interdisciplinary learning in different aspects. Kinniburgh and Byrd (2008) integrated mathematics, reading and social studies activities that engages and inspires students while covering the content and standards of three subject areas. Bogan, King-McKenzie, and Bantwini (2012) used Bogan Differentiated Instruction Model (BDIM) to integrate reading, science, and social studies to enhance inquiry, problem-solving, interest, critical thinking skills, and learning. This model combined major teaching concepts to develop interdisciplinary learning. However, Interdisciplinary curricula are time-consuming and use collaborative team work to invent that seems like a hard and disadvantage, but finally, the interdisciplinary approached inhibits many preferred skills that are needed by future colleges and employers. The use of interdisciplinary techniques helped students and their teachers improving in critical thinking, communication, creativity, pedagogy, and essential (Jones, 2009).

Collaborative Knowledge Construction is the discussions centered on the team on jointly solving a problem or carrying out a mission which helps to construct new knowledge. This method requires the use and adaptation of existing knowledge, so the groups produce and create the contexts of involved in joint problem-solving (Linehan & Mccarthy, 2001; Tscholl & Dowell, 2010). Fischer, Bruhn, Gräsel, and Mandl (2002) investigates that collaborative knowledge construction could be fostered by supporting students with visualization tools. Oehl and Pfister (2010) studied about E-Collaborative Knowledge Construction which can develop the learning discourse and support collaborative knowledge construction. Baloian and Zurita (2012) practiced a system called MCKC to supporting collaborative face-to-face tacit knowledge construction and sharing in ubiquitous scenarios.

Therefore, the interdisciplinary learning including history, geography, architecture, science and cultural study which is supported story-based learning curriculum is considered in this study. This interdisciplinary project aims to help students construct their knowledge by using collaborative knowledge construction.

3. Description of Story-Based Ubiquitous Learning in Promoting Social Study

History is the facts of all event happened in the pastime. Understanding the past makes us understand human thinking even more so that we can use the story in the past as an experience. Both from the mistake side, the successful side. It leads to the historical study process in order to obtain the knowledge and answers that reflect the facts of the pastime. It is necessary to use credible evidence to analyze and connect to the form of stories, such as evidence from a geographic location, Art and architecture, and cultures (education, religion, beliefs, customs, etc.).

Story-based learning is based on the concept of collaborating historical events in the form of stories. So it is necessary that a teaching course that learning or understanding content of knowledge originated from the recognition of knowledge in the form of story-based learning, which consorts with timeline’s history. Hence it is necessary for students to understand and memorize any content in the form of a story. (Learning in the form of story memorization could
make students understand and memorize knowledge. Nevertheless, comprehending knowledge’s content, students must understand history’s truth as the core including geography, science, architecture and art, culture’s knowledge too, as shown in Figure 1.

![Figure 1](image.png)

**Figure 1.** The Concept of Collaborate Historical Events in the Form of Story-Based Learning.

According to the process that history as the core knowledge, cooperatively constructed knowledge content under the concept of Story-based learning. It leads to the active learning’s design. Its objectives aimed to encourage students to prove the solution from a mission by themselves (self-learning); moreover, this active learning is considered as “Field Learning” too. Hence self-learning is necessary for students to learn through the real-world experience on the field trip.

In this study, five contents of Rattanakosin period (1782-1910) which are geography, history, science, architecture and art, culture (Figure 1.) are used in the field trip. The contents were mapped with King Rama I-V on four temples of Wat Arun, Wat Pho, Wat Phra Kaew, and Wat Suthat to make a historical story line. Then, teacher designed the questions for starting the collaborative knowledge construction. Finally, a video clip of every question was taken at the real location by the teacher and upload to Youtube. The overall framework of the proposed field learning method; from now on, called CULS, is presented in Figure 2. Moreover, the step-by-step of the CULS activities are described in Table 1.

![Figure 2](image.png)

**Figure 2.** Overall Framework of CULS’s Activity.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activities</th>
<th>Duration (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>The teachers introduce the CULS’s activity to grade 12th students before joining the field trip. All students are then divided into groups for rotation. After that, the teachers recommend the mobile application used in the activities with the hands-on practice.</td>
<td>60</td>
</tr>
<tr>
<td>Field trip</td>
<td>Once arrived the meeting point, the teacher lectured an overview of Rattanakosin history. This can make students eager to learn in the field</td>
<td>20</td>
</tr>
</tbody>
</table>

**Table 1: Learning activities.**
Each group then proceeds to visit a temple. The students then trigger the learning activities by taking their devices on QR code shown by the teacher. Once entranced the interactive form, the students will see their learning missions based on the location, starting from watching the video clip from their teachers to get introduced to the background of the location and leading them to the story. Then, the students are required to work on the assignments requiring them to accomplish some missions with peers. At this point, the students can inquire the historical knowledge in association with several subjects according to the received missions. In the meantime, they have to perform many skills to make the missions successfully. After the period of 60 minutes is over, each group rotate to different temples.

Debriefing

The first 60 minutes, teacher and students together discuss the correct answer. 60 minutes later, each group presented a historic timeline from the correct answer. This face-to-face activity in the classroom, considered as debriefing session, helped students to not only diminish their misunderstanding, but also forming the socio-cultural knowledge with the teachers’ suggestions.

Students took a questionnaire to assess their 21st skill century performance from their responses.

Finally, students took a quiz in EdPuzzle as a summative assessment on their gained knowledge from the entire activities.

<table>
<thead>
<tr>
<th>4. Research Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1. Participants</td>
</tr>
</tbody>
</table>

There were 26 grade 12th students who participated in this research study. All students held the fundamental knowledge of Rattanakosin period, which were taught in a regular class by the same teacher, and have had mobile experiences.

<table>
<thead>
<tr>
<th>4.2. Instruments</th>
</tr>
</thead>
</table>

There were three main instruments used in this study. First, the learning activities in CULS were used as a major instrument. The data used in this study was collected from the answers/works submitted in 12 missions taken at four temple sites (three missions each). Validated by two experienced social studies teachers, All learning activities were designed to assist the students to effectively learn in the field study. Moreover, the teachers have developed the scoring rubric to evaluate these submissions fairly (total score = 100). Second, the summative assessment is used as a quiz to assess the students’ socio-cultural knowledge covered in the learning activities. Seven open-ended question items were developed in EdPuzzle to collect the students’ understanding towards Rattanakosin history. The evaluation is done based on the scoring rubric (total score = 100). Discrimination and reliability test has been performed and passed the acceptable values. Third, to assess students’ 21st skills performed during the CULS activities both from the field-trip and debriefing phases, the questionnaire was adapted from Gallegos and Peeters (2011) with 14 Likert-scale items supplemented with open-ended questions. This instrument was designed to assess following skills: analytical, sketching, communication, collaboration, critical thinking, and presentation. The tool is accepted for reliability with Cronbach’s alpha of 0.892, while IOC test was done with multiple experts.
4.3. Procedure

The participants were first divided into five groups (5 people/group). Every member of each group has their responsibility to help achieve the missions. The procedure used in this research study follows the CULS phases, as presented in Table 1. After all activities were completed, all participants took questionnaire and quiz for 60 and 30 minutes respectively. Figure 3, 4 and 5 show some of the learning activities of the field trip activities, debriefing session in the class, and the summative quiz, respectively.

Figure 3. In-Field Collaborative Ubiquitous Learning Activities.

Figure 4. Story-based Collaborative Knowledge Construction.

Figure 5. Summative Assessment of Socio-Cultural Knowledge.
5. Results

5.1. Learning Achievements

Based on the evaluation results of CULS learning activities, it was found that most groups of students could perform at the high level of the learning achievements (M = 74.75, SD = 7.47), as shown in Table 2. This implies that the students could follow the on-going learning activities effectively upon their collaboration and arrangement. They gained a high level of understanding of the integrated contents of history, geography, architecture, science and culture study of Rattanakosin period.

Moreover, a median-split technique was performed (Med = 75.00) to group their learning achievements into two categories: Low performance (LP) and High performance (HP).

To further investigate the individual students’ socio-cultural learning achievements, the results from their quiz were analyzed. As shown in Table 3, it was found that those who were in HP group could significantly outperform than those who were in LP group. This confirms that their individual understanding of the topic was in the alignment with their collaborative ubiquitous learning achievements. Therefore, they could construct their knowledge.

Table 2: Results of the in-field group learning performance.

<table>
<thead>
<tr>
<th>Group</th>
<th>Score (M ± SD)</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>85.00</td>
<td>Highest</td>
</tr>
<tr>
<td>B</td>
<td>83.75</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>72.50</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>81.25</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>80.63 ± 7.96</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Difference of quiz score results.

<table>
<thead>
<tr>
<th>Group</th>
<th>Score (M ± SD)</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>56.05 ± 22.80</td>
<td>65.00*</td>
</tr>
<tr>
<td>HP</td>
<td>59.41 ± 17.87</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05

5.2. 21st Century Skills Performance

Based on the questionnaire results, we found that the high performing students could show significantly better performance than those in the other group on analytical, sketching, communication and collaboration, as shown in Table 4. Furthermore, their qualitative responses on such questionnaires were presented in Table 5. It can be implied that the HP students could provide more advanced responses and sophisticated works than those of the other groups.

Table 4: Difference of 21st century skills achievement.

<table>
<thead>
<tr>
<th>Skill</th>
<th>Score (M ± SD)</th>
<th>U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical (ALT)</td>
<td>3.50 ± 0.53</td>
<td>4.00 ± 0.55</td>
</tr>
<tr>
<td>Sketching (SKT)</td>
<td>3.00 ± 1.15</td>
<td>3.43 ± 0.85</td>
</tr>
<tr>
<td>Communication (CMN)</td>
<td>3.30 ± 1.16</td>
<td>3.93 ± 1.00</td>
</tr>
<tr>
<td>Collaboration (CLT)</td>
<td>3.58 ± 0.88</td>
<td>4.05 ± 0.78</td>
</tr>
<tr>
<td>Critical thinking (CTC)</td>
<td>3.80 ± 0.63</td>
<td>3.93 ± 0.73</td>
</tr>
<tr>
<td>Presentation (PST)</td>
<td>4.00 ± 0.82</td>
<td>3.79 ± 0.80</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01
Table 5: Qualitative responses on 21st century skills.

<table>
<thead>
<tr>
<th>Skill</th>
<th>Low performance (LP)</th>
<th>High performance (HP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical (ALT)</td>
<td>1. Because Wat Arun in the past were very high architectural building compared to the surrounding area. It is also a temple located near the river, so it has beautiful elements. 2. The Hindu-Brahmin Belief of Cosmology. Wat Arun is liken as Mount Meru, which is like the center of the universe. Phra Chan and Phra Sun Pier are liken as the moon and the sun, surrounding Mount Meru is the center of the universe.</td>
<td>Thai society respected to the belief of Tripoom (Three World). Tripoom are replicated in the architecture of the temple. Each location in temple absolutely reflected to the belief of Tripoom. For example, the gate of the prang is liken as the gate of the universe. The vast yard is liken as the Si Tandon sea, the sea surround Mount Meru. In the middle of the sea there is a mountain, which is Prang (Wat Arun Pagoda).</td>
</tr>
<tr>
<td>Sketching (SKT)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication (CMN)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand and Cambodia related each other in various aspect. Both in the context of arts, culture, or even politics. Thus they inevitably exchanged in culture. The Temple of the Emerald Buddha was influenced by Angkor Wat. Including to Ramayana and other arts. Both Thailand and Cambodia are influenced by India.</td>
<td>Angkor Wat. In Thailand, this concept has been adopted in the Rama I period. He has the belief that the king is the goddess, comparable to Rama in the Ramayana. This literature has been taken as a mural painting in the Angkor Wat in Wat Phra kaew. Because in the reign of King Rama IV wanted to move Angkor Wat to Siam Kingdom but it's impossible. So his majesty directed to make a model in Wat Phrakaew instead.</td>
<td></td>
</tr>
</tbody>
</table>

To further understand the relations among those measured 21st-century skills in CULS, the correlation test was performed on each pair of skills. It was found that there was significant relationship between ALT and CMN/CTC/PST, SKT and CMN/PST, CMN and CLT/PST, and CLT and PST. This means that those who are good at communication can give a presentation, for example.

Table 6: Pearson’s correlation efficiency between 21st century skills.

<table>
<thead>
<tr>
<th>Skill</th>
<th>ALT</th>
<th>SKT</th>
<th>CMN</th>
<th>CLT</th>
<th>CTC</th>
<th>PST</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALT</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SKT</td>
<td>0.31</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMN</td>
<td>0.63*</td>
<td>0.71*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLT</td>
<td>0.24</td>
<td>0.12</td>
<td>0.82**</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTC</td>
<td>0.89**</td>
<td>0.32</td>
<td>0.18</td>
<td>0.34</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>PST</td>
<td>0.66*</td>
<td>0.74*</td>
<td>0.86**</td>
<td>0.73*</td>
<td>0.37</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*p < 0.05, **p < 0.01

6. Conclusions

This study conducted an investigation on the effects of collaborative ubiquitous learning in promoting socio-cultural knowledge and skills in the 21st century based on the novel in-field learning approach, CULS. Taking Rattanakosin period as the learning topic in CULS, the learning activities were developed accordingly in focusing the collaborative knowledge construction among
peers in the group in acquiring the knowledge in the actual contexts, in this study four temples. This study report several findings. First, every student could catch the socio-cultural knowledge in accordance with the performance of their groups. Second, the high performing students could outperform 21st-century skills than the others, e.g., collaboration, communication, and analytical skills. Lastly, those who were good at presentation hold several skills needed in the 21st century. The findings of this research could be taken into consideration in further design collaborative ubiquitous learning activities.

However, the current study has some limitations that should be resolved and improved. First, the number of participants in this study was relatively small; therefore more number of participants across different contexts and background would be challenged to study for further generalization of this proposed approach. Second, other integrated contents could be applicable with this approach, such as sciences and languages; thereby a serious attention on learning activities could be altered accordingly. Finally, for the intensive use of this approach, a development of native mobile application could be considered, not only for user-friendly aspect but also for learning analytics purpose.

References


Fostering Pre-service Science Teachers’
Technological Pedagogical Content
Knowledge of Mobile Laboratory Learning in
Science

Phattaraporn PONDEE\textsuperscript{a}, Sasivimol PREMTHAISONG\textsuperscript{a} & Niwat SRISAWASDI\textsuperscript{b,c}\textsuperscript{*}

\textsuperscript{a} Science Education Program, Faculty of Education, Khon Kaen University, Thailand
\textsuperscript{b} Division of Science, Mathematics and Technology Education, Faculty of Education, Khon Kaen University, Thailand
\textsuperscript{c} Institute of Learning and Teaching Innovation, Khon Kaen University, Thailand

*niwsri@kku.ac.th

Abstract: The framework of technology pedagogical and content knowledge (TPACK) is currently considered as essential qualities of knowledge for highly qualified teachers in the 21st century education. This knowledge framework has been suggested by researchers to be helpful in preparing literate pre-service teachers in the use of digital technology in their classroom teaching practices of specific subject contents. As such, the researchers have implemented the framework for designing a module of the pedagogy of Mobile Laboratory Learning in Science (MLLS) for pre-service science teachers. The purpose of this study was to examine an efficacy of the MLLS for enhancing pre-service science teachers’ TPACK. The study participants were 119 pre-service science teachers in general science teacher education program at a Rajabhat university of Thailand, and they were assigned to participate with the module in four weeks. The preliminary results showed that the pre-service science teachers have improved their conceptions of TPACK of mobile laboratory learning in science to higher level after interacting with the MLLS module.

Keywords: TPACK, mobile learning, science laboratory, mobile experimentation, pre-service teacher

1. Introduction

Mobile devices are recognized as an emerging technology with the potential to facilitate teaching and learning strategies that exploit individual learners’ context (Jeng et al., 2010). Nowadays, the use of mobile devices in education, as mobile learning, is popular educational activity that many researchers have implemented in many subject areas for improving the effectiveness of instruction. Mobile learning makes sense only when the technology in use is fully mobile and when the users of the technology are also mobile while they learn. These observations emphasize the mobility of learning and the significance of the term mobile learning (El-Hussein, M. O. M., & Cronje, J.C., 2010). Mobile technology offers a plethora of features and benefits that enable it to break the educational system wide open, engaging students in new ways and making educational experiences more meaningful. It offers flexibility in when the learning take place, personalized content, teaches relevant skills for the future. Mobile technologies offer a new paradigm in connectivity, communication, and collaboration in our everyday lives. It is anywhere, anytime learning indeed (McQuiggan et al., 2015). In context of science education, this has led to several research initiatives that investigate the potential of the educational paradigm shift from the traditional science teaching approaches to mobile learning in science. Currently, researchers in science education community have concentrated on investigating effective ways to facilitate science learning in authentic context with the support of mobile technology.

Mobile learning in science seems to be a pedagogic way to deliver the authenticity of scientific phenomena into science teaching and learning, both formal and informal contexts. More
precisely, mobile learning can (a) engage students in experiential and situated learning without place, time and device restrictions, (b) enable students to continue learning activities, initiated inside the traditional classroom, outside the classroom through their constant and contextual interaction and communication with their classmates and/or their tutors, (c) support on-demand access to educational resources regardless of students’ commitments, (d) allow for new skills or knowledge to be immediately applied and (e) extend traditional teacher-led classroom scenario with informal learning activities performed outside the classroom (Gomez et al., 2014). With the advancement of mobile technology, learning in real-world context, outside the classroom, is no longer a problem and learning combined with authentic contexts becomes easier for science-based education. However, a challenge for mobile learning in science related to teachers’ adoption of mobile technologies in their science class emerged from the fact that they were not prepared effectively in investigating the affordances of mobile technologies for their pedagogy and the content they teach to make informed decisions (Kukulska-Hulme et al., 2008).

The big challenge for mobile learning in science related to teachers’ adoption of mobile technologies in their science class emerged from the fact that they were not prepared effectively in investigating the affordances of mobile technologies for their pedagogy and the content they teach to make informed decisions (Kukulska-Hulme et al., 2008). We believed that a major obstacle of science teachers for using mobile technology in the classroom is the lack of sufficient knowledge and skills of how to utilize it pedagogically into the science class. To overcome this obstacle, Smarkola (2008) has suggested training preservice teachers in educational technology during their initial teacher education. To achieve that, their knowledge of how to use mobile technology in science teaching and learning is very important for gaining high quality teaching competencies in science. Srisawasdi (2014) stated that not only all students need a more robust process of technology-enhanced science learning, but teachers also need to be educated and prepared for gaining high quality teaching competencies by integrating digital technologies, such as mobile devices, into their classroom teaching practice.

Preparing preservice teachers for digital technology integration is a complex job given the fast-changing nature of digital technology, such as mobile devices, and the multiple sources of knowledge which need to be synthesized. Meaningful use of digital technology in the classroom requires the teachers to integrate technological affordances with pedagogical approaches for the specific subject matter to be taught (Jonassen et al., 2008; Mishra & Khoeler, 2006) To be an technology-integrating teacher means going beyond technology skills, and developing an understanding of the complex relationships between pedagogy, content and technology (Hughes, 2005; Keating & Evans, 2001; Lundeberg, Bergland, Klyczek & Hoffman, 2003; Margerum-Leys & Marx, 2002; Niess, 2005; Zhao, 2003). Hence, a teacher preparation program should provide students with the knowledge, skills, and experience needed to integrate technology effectively in their future practice, considering the interactions between pedagogy, content and technology. This integrated form of contextualized knowledge has been recently referred to as technological pedagogical and content knowledge, shortly called TPACK (Mishra & Khoeler, 2006; Thompson & Mishra, 2007). TPACK is currently considered as possessing the essential qualities of knowledge for highly qualified teachers in the 21st century (Srisawasdi, 2014). The TPACK framework stresses the importance of the interactions between these bodies of knowledge. These include pedagogical content knowledge (PCK) as addressed by Shulman (1987), technological content knowledge (TCK) referring to how ICT and content influence each other, technological pedagogical knowledge (TPK) addressing how pedagogies change while using technology, and technological pedagogical content knowledge (TPACK), which is the knowledge that emerges from interactions among the three knowledge domains (Koehler & Mishra, 2008). The TPACK framework has been used to re-design teacher preparation programs and teacher development workshops (i.e. Niess, 2005; Niess, 2007; Niess, Suharwoto, Lee, & Sadri, 2006; Shoffner, 2007; Burns, 2007). Special emphasis has been given to incorporating technology design projects as avenues to help teachers develop connections between TK, PK, and CK (i.e. Niess, 2005; Mishra & Koehler, 2006; Srisawasdi, 2014). TPACK may new directions for teacher educators in solving the problems associated with infusing ICT into classroom teaching practice and learning process (Chai et al., 2011 cited in Srisawasdi, 2012). However, mobile learning is especially under-theorized in teacher education (Kearney & Maher, 2013), despite the need to inform teachers of
the value of mobile technologies and how to integrate them effectively into their classes (Schuck, Aubusson, Kearney, & Burden, 2013). Moreover, teacher support and teacher training for TPACK in mobile learning in science have been the least explored topics in science teacher education research. The goal of this study was to explore effect of TPACK-oriented learning module for pre-service science teacher on their TPACK of mobile laboratory learning in science. This paper presents an investigative result of the transformation of TPACK in mobile laboratory learning in science in the pre-service science teachers.

2. Literature Review

2.1. Technological Pedagogical and Content Knowledge (TPACK)

In recent years, many researchers in the field of educational technology have been focused on the role of teacher knowledge on technology integration (Hughes, 2005; Koehler & Mishra, 2005, 2008; Mishra & Koehler, 2006; Niess, 2005. The term TPACK also known as TPCK; Koehler & Mishra, 2005 has emerged as a knowledge base needed by teachers to incorporate technology into their teaching. Technological pedagogical and content knowledge TPCK was introduced to the educational research field as a theoretical framework for understanding teacher knowledge required for effective technology integration (Mishra and Koehler, 2006. The TPCK framework acronym was renamed TPACK for purpose of making it easier to remember and to form a more integrated whole for the three kinds of knowledge addressed: technology, pedagogy, and content) Thompson and Mishra, 2007. This framework builds on Shulman’s 1986 construct of pedagogical content knowledge PCK to include technology knowledge.

![Figure 1. Technological Pedagogical and Content Knowledge (TPACK) framework](http://tpack.org).

TPACK was first proposed by Mishra and Koehler 2006 to describe an integrated connection between content knowledge, pedagogical knowledge, and technological knowledge. The framework illustrates essential knowledge of how teacher could integrate technological tools into their teaching of specific content in their school practice (Srisawasdi, 2012). It is most commonly represented in a drawing of Venn diagram with three overlapping circles of knowledge. The TPACK diagram includes three core categories of knowledge such as the process and practices or methods of teaching and learning called pedagogical knowledge PK, the knowledge about the actual subject matter that is to be learned or taught called content knowledge CK, and the knowledge about standard technologies and the skills required to operate particular technologies called technological knowledge TK. The Mishra and Koehler 2006’s framework also process that these three core types of knowledge results in four additional types of knowledge including the knowledge about particular teaching practice that appropriately fit the nature of
specific subject content called pedagogical content knowledge (PCK), the knowledge about the existence, component and capabilities of standard technologies that could be appropriately used to particularly support in the processes and practices or methods and learning called technological pedagogical knowledge (TPK), the knowledge about the manner which knowledge of actual subject matter could be manipulated into appropriate representations by application of standard technologies called technological content knowledge (TCK), and knowledge about the manner which the transactional relationship between knowledge about content (C), pedagogy (P), and technology (T) was dynamic in order to develop appropriate, context-specific, strategies, and representations for better learning of content knowledge called technological pedagogical content knowledge (TPACK).

Seven components (see Figure 1) are included in the TPACK framework. They are defined as:

1. Technology knowledge (TK): Knowledge about various technologies, ranging from low-tech technologies, such as pencil and paper, to digital technologies, such as the Internet, digital video, interactive whiteboards, and software programs.
2. Content knowledge (CK): Knowledge about the actual subject matter that teachers must know about to teach.
3. Pedagogical knowledge (PK): Knowledge about the methods and processes of teaching such as classroom management, assessment, lesson plan development, and student learning.
4. Pedagogical content knowledge (PCK): Knowledge that deals with the teaching process (Shulman, 1986). Pedagogical content knowledge is different for various content areas, as it blends both content and pedagogy with the goal to develop better teaching practices in the content areas.
5. Technological content knowledge (TCK): Knowledge of how technology can create new representations for specific content.
6. Technological pedagogical knowledge (TPK): Knowledge of how various technologies can be used in teaching.
7. Technological pedagogical content knowledge (TPACK): Knowledge required by teachers for integrating technology into their teaching in any content area. Teachers, who have TPACK, act with an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK).

For the science education community, the efforts of current science education reforms expect science teachers to integrate digital technology and inquiry-based teaching into their instruction (Srisawasdi, 2014). In this light for science teacher education, both pre-service and in-service science teachers are targeted to improve teaching proficiency based on the implementation of TPACK in many kinds of instructional intervention, i.e. coursework, training, and workshop, by teacher education researchers and educators (Srisawasdi & Panjaburee, 2014). As such, it is clearly that the development of science teacher education program based on TPACK framework is an important for preparing both pre-service and in-service science teacher to gaining high quality teaching competencies by integrating technologies into their science teaching practice.

2.2. Mobile Learning and Teacher Education

Mobile devices have become attractive learning devices for education, and teachers’ adoption of mobile technologies have been recognized as a potential way for transforming traditional teaching into student-centered approach. Because of the rapid growth of mobile technologies as learning devices and its features and functions supported active learning, teacher education programs need to implement theoretically and pedagogically sound mobile learning initiatives in order to effectively integrate mobile devices for facilitating students’ learning process (Newhouse et al., 2006). Passey and Zozimo (2015) suggested that when using handheld devices there is a need for teachers to consider how the learning environment might be expanded beyond the classroom, due to the portability features of the devices. Currently, researchers and teacher educators have showed an increasing interest in the integration of mobile technologies into teacher education in both pre-
service and in-service teacher contexts (Baran, 2014). With being more ubiquitous of mobile technologies, the pedagogical affordances of mobile devices will continually be explored in teaching contexts. Especially, mobile learning is recognized by teacher education researchers as a beneficial approach in extending both pre-service and in-service teachers’ learning experiences and enhancing their mobile technology integration skills (Baran, 2014). For example, teacher education events need to identify the many applications (Apps) that can meet specific subject and topic needs, and teachers also need to be aware of both the benefits and limitations of handheld devices for teaching and learning in both formal and informal education. Baran (2014) mentioned that there are two methods for integrating mobile learning into teacher education contexts; (a) teacher training about mobile learning, where teachers learn how to integrate mobile tools into their classrooms, and (b) teacher training with mobile learning, where teachers interact to learn with mobile technology.

3. Methods

3.1. Study Participants

A total of 119 pre-service science teachers, 4th year students, enrolled in the Classroom Management and Learning Environment for Science Learning course at General Science Program, Faculty of Education, Roi Et Rajabhat University, Thailand, participated in this study. All of them came from four sections of the enrolled course. They were 93 females and 26 males and they age between 21-22 years old. All of them did have satisfactory basic information and communication technology (ICT) skills but they had not any experience with using digital technology and mobile devices for science experiments and science instruction before.

3.2. Detail of the Mobile Laboratory Learning in Science (MLLS) module

This research employed a quasi-experimental research design that involved two phase of data collection – pre and post module. The participants were introduced into a module of Mobile Laboratory Learning in Science (MLLS) for pre-service science teacher. The MLLS module consisted of 4 three-hour weekly lecture and practices, and divided into four lessons, as shows in Table 1.

Table 1: Details of the MLLS module for pre-service science teacher preparation based on TPACK

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Week</th>
<th>Domain</th>
<th>Learning strategy</th>
<th>Knowledge object</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Introduction to microcomputer-based laboratory (MBL), a digital technology tool in science learning</td>
<td>Interactive lecture and demonstration</td>
<td>TK</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Pedagogy of inquiry-based learning in science with the support of MBL</td>
<td>Interactive lecture and demonstration</td>
<td>TCK, TPK, TPACK</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Hands-on practical work with mobile MBL</td>
<td>Hands-on practical work</td>
<td>TCK, TPK, TPACK</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Designing mobile MBL learning activity in science</td>
<td>Hands-on practical work</td>
<td>TPACK</td>
</tr>
</tbody>
</table>

For the MLLS module, the first lesson is an introduction of the sensor-based digital technology tool, called microcomputer-based laboratory (MBL), in science learning. In this lesson, the instructor (the first author) introduced the history of MBL in science education and presented the tool and its information in the class. Moreover, the instructor also demonstrated how to use the
tool in school science laboratory. Figure 2 illustrates the introduction of MBL in science learning class.

![Figure 2](image1.png)

**Figure 2.** An Illustration of the first lesson class, an introduction of MBL for preservice science teachers

In the second lesson, the instructor introduced them the pedagogy of inquiry-based learning in science in both instructional strategies, i.e. learning cycle-oriented and openness-oriented approach (Srisawasdi, 2016). Then, they were presented to a mini lesson on how to use MBL as an inquiry tool in the learning process of science. In addition, the instructor also showed the pedagogic case for implementing technology-enhanced science learning with the support of sensor-based MBL, as shows in Figure 3.

![Figure 3](image2.png)

**Figure 3.** An Illustration of the pre-service science teachers’ practice in class using sensor-based MBL in the second lesson

For the hands-on practical work with mobile MBL in the third lesson, the instructor assigned the pre-service teachers to conduct a scientific inquiry with mobile MBL outside the classroom. The mobile MBL-based scientific inquiry was focused on the investigation of water quality of various resources within the university. They were assigned to conduct the investigation in small groups by using smartphone and MBL connected via Bluetooth. Figure 4 illustrates the pre-service science teachers with conducting the water quality experiment with mobile laboratory.
In the last lesson of this module, all small groups of the pre-service science teachers have been assigned to collaboratively design their own learning activity of mobile laboratory learning in science. Before the collaborative activity to design the learning activity, the instructor presented a summary of the science learning activity of water quality experiments with the support of mobile MBL and then digested the TPACK framework and components regarding the water quality learning activity. After, they were encouraged to brainstorming and then independently design a science learning activity with utilizing the mobile MBL as inquiry tool. Figure 5 illustrates the pre-service science teachers’ presentation of teaching idea regarding the implementation of mobile MBL-based inquiry learning in science.

3.3. Data Collection and Analysis

Before the first and after the last week of this module, the study participants were asked to complete a series of open-ended question regarding TPACK in mobile laboratory learning in science for 40 minutes as pretest and posttest. In this study, the researchers focused on only four components regarding technology-oriented TPACK constructs, i.e. TK, TPK, TCK, and TPACK. This questionnaire was validated the construct and communication validity by four experts who hold Ph.D. in science and technology education, and educational technology. When assessing each aspect of TPACK for mobile laboratory learning in science, the respondents (pre-service science teacher)’ views were categorized in four levels (Informed, Mixed, Naïve, and Unclear) adapted from Bartos and Lederman (2014)’s idea of teaching conception analysis. For this study, if by contrast, a respondent provides a response consistent across the entire questionnaire that wholly congruent with the target response for a given aspect of TPACK, they were labeled as “Informed.”
If by contrast, a response is either only partially explicated, and thus not totally consistent with the targeted response regarding TPACK, or if a contradiction in the response is evident, a score of “Mixed” is given. A response that is contradictory to accept views of specific aspect of TPACK under examination is scored as “Naïve.” Lastly, for scores that are incomprehensible, intelligible, or that, in total, indicate no relation to the particular aspect, a categorization of “Unclear” is assigned (Lederman et al., 2014). In regard to concerns about the open-ended format of relationship between content knowledge, pedagogy knowledge, and technology knowledge, any essay-type questions require additional effort by the researchers to discern the level of TPACK of the preservice science teachers. To identify general trends in the preservice science teachers’ TPACK at the module, this type of open-ended instrument is typically utilized, and can be facilitated by the four-tired assessment scale. The format also best serves the overarching intent of the instrument, which is to create profile of preservice science teachers’ TPACK.

4. Results and Discussions

According to explore the effect of MLLS module on pre-service science teachers’ partial TPACK components such as TK, TPK, TCK, and TPACK, the results shows in Table 2.

Table 2: Percentage of the pre-service science teachers’ TK, TPK, TCK, and TPACK categorized as holding unclear, naïve, mixed, and informed views of TPACK

<table>
<thead>
<tr>
<th>N=119</th>
<th>Technological Knowledge (TK)</th>
<th>Technological Pedagogical Knowledge (TPK)</th>
<th>Technological Content Knowledge (TCK)</th>
<th>Technological Pedagogical Content Knowledge (TPACK)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Unclear</td>
<td>0.00</td>
<td>0.00</td>
<td>0.84</td>
<td>0.00</td>
</tr>
<tr>
<td>Naïve</td>
<td>19.33</td>
<td>10.08</td>
<td>47.90</td>
<td>34.45</td>
</tr>
<tr>
<td>Mixed</td>
<td>78.99</td>
<td>88.24</td>
<td>51.26</td>
<td>63.03</td>
</tr>
<tr>
<td>Informed</td>
<td>1.68</td>
<td>1.68</td>
<td>0.00</td>
<td>2.52</td>
</tr>
</tbody>
</table>

Individual profiles were developed based on holistic analysis of TPACK responses. Results indicated that the majority of preservice science teachers (a) were Naïve view in their conception of TPACK in both prior and finish to instruction, (b) increase their understanding from Naïve to Mixed such as Technological Knowledge (TK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK) and (c) increase their understanding to Informed degree for Technological Pedagogical Knowledge (TPK), and Technological Content Knowledge (TCK).

In summary, the results of this preliminary study provided evidences that preservice science teachers’ TK, TPK, TCK, and TPACK has been fostered during their interacting with the MLLS module for preservice science teachers. This finding is consistent with Jimoyiannis (2010), Jang & Chen (2010), Srisawasdi (2012), Srisawasdi (2014), and Srisawasdi & Panjaburee (2014) that implementation well-designed coursework could foster preservice or in-service science teachers’ essential knowledge of TPACK.

5. Conclusion

This study reported a result of an implementation of TPACK-oriented pedagogical module of mobile laboratory learning in science for preservice science teachers and the findings revealed the preservice science teachers have been fostered their TK, TPK, TCK, and TPACK on the pedagogy of mobile laboratory learning in science. Thus, this implies the possibility of enhancing preservice science teachers’ TPACK of mobile learning in science and it could be an effective way to develop
their essential knowledge of technology-enhanced learning in science to address the 21st century education.

Acknowledgements

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An Emic Perspective on Students’ Learning Experiences Using Augmented Reality

Fariza KHALID* & Su Luan WONGb

aUniversiti Kebangsaan Malaysia, Malaysia
bUniversity Putra Malaysia, Malaysia
*fariza.khalid@ukm.edu.my

Abstract: The existence of technology has helped learning activities to become more exciting and more meaningful. Augmented reality (AR) is one of the emerging technologies that has gained attention from educators, as it provides unique learning experiences to learners. This study seeks to understand learners’ experiences in using AR as part of their learning activities. Using a qualitative research approach, this study involved 24 university students who were enrolled on an Educational Technology course. The students were exposed to the use of AR so as to drive their motivation, and were required to develop their own AR projects as part of the course assessment. Data were generated through one-to-one interviews, which were later analysed using thematic analysis. The findings indicate that students valued the use of AR as a tool that stimulated their creativity and critical thinking. Although students found their group AR task challenging, they agreed that the task fostered collaborative values in themselves and helped them expand their communication skills. This paper also discusses the potential of AR in developing the twenty-first century skills.

Keywords: augmented reality, AR, education, motivation, twenty-first century skills

1. Introduction

With the assistance of technology, teaching and learning activities are made more interesting and meaningful. The emergence of new technology offers wider opportunities for educators to design fun and engaging teaching and learning activities. Digital media, for example, has increasingly made its way into educational settings, providing students with learning opportunities around interactive simulations and educational games. Augmented reality (AR) is an emerging technology that has gained wider attention from educators for its benefits in strengthening learning experiences and helping learners to develop a better conception of certain topics (Danakorn et al., 2013). AR refers to “human-computer-interaction, which adds virtual objects to real senses that are provided by a video camera in real time” (Ludwig & Reimann, 2005, p. 4); in other words, AR is a technology that “allows computer generated virtual imagery to exactly overlay physical objects in real time” (Zhou, Doh & Billinghurst, 2008, p. 193).

For teaching purposes, AR can be seen as a tool that has vast potential in taking technology-integrated learning processes to the next level (Dunleavy & Dede, 2014; Vincenzi et al., 2003). AR has been reported to have many advantages to spur learning. Hamilton & Olenawa (2010) note that AR can provide more contextual learning, enabling the acquisition of certain skills through the simulation of students’ cognitive thinking. It has been shown in many studies that learners learned better when they used AR materials, as compared to other methods such as slide presentations or text materials (Hedley, 2003; Sin & Zaman, 2010; Seo et al., 2006; Nischelwitzer et al., 2007). Using AR, learners can also learn at their own pace, as they can re-scan the overlay as many times as they wish until they reach a solid understanding to conceptualise the content given (Wei et al., 2015). This can in turn help develop learners’ long-term memory retention (Vincenzi et al., 2003; Valimont et al., 2002).

Kaufmann et al. (2000) in their research report that students learning using AR demonstrated significant satisfaction with their learning. They were also found to be more motivated to explore more things using the technology. Similar findings were reported by Juan et al. (2008) and Liu et al.
(2009), who posit that learners see AR as fun, which makes them willing to experience it again. In studying an alternate reality game, Liu et al. (2009) found that the GPS-based game increased students’ motivation, creativity and exploration more than its paper-based counterpart. The use of AR was found to be more suited to individual exploration or learning. However, this might not always be the case, as Radu (2014) notes that students showed a greater sense of collaboration in shared meanings with their peers when they learn using AR. This is also supported by Freitas and Campos (2008), who observed that class collaboration increased when students used a shared display for observing AR experiences.

The past research has undeniably demonstrated the benefits of AR, especially in the education sector. It can be concluded that, through the integration of AR as a learning medium, learners will benefit more – they will be more motivated, gain a deeper understanding and memorise better. Using AR as a medium, collaborative work can also be cultivated. Previous research, however, has focused on how the use of AR, which was provided by educators or researchers, benefitted students’ learning. Very little research has looked at how students learn when they are involved not only as the end users of an AR product, but also when they take a role in developing AR products themselves. This research, therefore, aims to gain insights into students’ learning when they both use AR and develop their own AR projects.

2. **Methodology**

This research employed a qualitative approach, which aimed to focus on the understanding of learners’ experiences in learning with and about AR. An interpretivist methodology aims to provide “contextual understanding on the basis of rich and detailed data” (Mason, 2002, p. 3). The study participants were second-year 24 (6 male and 18 female) students who were enrolled on an Educational Technology course. These students were a subset of the overall 121 students who took this course. All of the students had some skills in developing videos and multimedia stuffs during their first year when they took Computer in Education course. However, none of them had prior experience in using AR, or developing AR material. For the purposes of this study, a tutorial group was chosen based on volunteerism.

The course provides skills related to the domains of educational technology which involves design, development, implementation as well as evaluation of learning materials. Throughout the semester, students were also exposed to current topics related to the use of technology for teaching and learning purposes, e.g., Web 2.0, communities of practice, cybersecurity, MOOCs, augmented reality, eLearning, m-learning and micro-learning. There were AR materials developed for certain topics i.e., MOOC, communities of practice and domains of educational technology. AR cards were also used to spur students’ motivation in starting their group projects.

![Figure 1: Examples of AR cards used to present the steps in developing a CoP](image-url)
In addition to being end-users of AR, students were given a group task to create their own AR materials. The group-based work took four weeks to complete, and at the end of the semester all groups presented their projects through by talking about their research. Six topics were assigned to the students which were: cybersecurity, MOOCs, augmented reality, eLearning, m-learning, and micro-learning.

Data collection was done using one-to-one interviews, which were conducted during the final week of the semester. Interview data was transcribed and coded using Nvivo using a thematic analysis (Braun & Clarke, 2006). After the coding was completed, codes were classified into categories (Miles & Huberman, 1994). In doing this, we made the ‘link’ between the data (Denscombe, 2010). As a result, several categories emerged as presented in the findings section.
3. Research Findings

The objective of this study was to explore learners’ experiences in using AR as part of their learning activities and assessment. The two research questions that we tried to answer are: a) How did students view the use of AR in their learning activities?; and b) What kind of learning did students experience when they developed their own AR projects?

3.1. Students’ views of the use of AR in their learning activities

Several themes emerged through the analysis, as indicated in Table 1.

Table 1: Students’ views of the use of AR

<table>
<thead>
<tr>
<th>Themes</th>
<th>Number of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fun activity</td>
<td>20</td>
<td>83.33%</td>
</tr>
<tr>
<td>Convenience of AR</td>
<td>18</td>
<td>75.0%</td>
</tr>
<tr>
<td>Interest in learning new topics</td>
<td>15</td>
<td>62.5%</td>
</tr>
<tr>
<td>Easy to memorise</td>
<td>15</td>
<td>62.5%</td>
</tr>
<tr>
<td>Self-paced/directed</td>
<td>11</td>
<td>45.83%</td>
</tr>
<tr>
<td>Ubiquity of AR</td>
<td>10</td>
<td>41.66%</td>
</tr>
<tr>
<td>Authentic activity</td>
<td>9</td>
<td>37.5%</td>
</tr>
<tr>
<td>Challenging</td>
<td>8</td>
<td>33.3%</td>
</tr>
</tbody>
</table>

The analysis shows that participants mentioned that the use of AR had motivated them to learn about the new topic and new technology. They were surprised when they used AR for the first time. The excitement of exploring a new thing made the task more interesting for them. For example, one of the participants said:

When I was first exposed to AR, I was surprised and stunned. How come a piece of paper can project a moving video? I thought it was magic, seriously. And it makes me so excited to know more about AR. I am sure that AR can be a motivating factor for other learners. (Aryan)

The use of AR also developed their interest in exploring the topic given for their group task. This was due to the requirement for them to gather related information and then turn it into a sequence, using trigger images and overlay videos. For instance, Denise said:

The use of AR definitely stimulates students’ interest to learn about the topic. Not only I experienced the feeling, I am sure that others are feeling the same too. I will definitely use AR in my classes or perhaps in my presentations in different classes next semester! (Denise)

The mobile app that was used for these activities was Aurasma. To be able to scan the trigger images, students had to install the app on their mobile phones. Since all the students were using a smartphone, they had no problem in accessing the app. The convenience of using their own smartphones made the activities smooth and easy:

What is beautiful about AR is that it uses mobile phones to scan. It is handy, everybody has got their own device so I think it is quite convenient, and motivating too. (Umar)

Furthermore, students also found AR was fun to use. Moreover, the overlay videos used were short in length but full of important points, and that made their learning more meaningful. One participant said:

When I was using AR, I can say that I learned better because we have a lot of videos to
scan but in smaller chunks. It is easy to digest in a very short period of time. And what’s more, it is fun! It brings the learning process to the next level of motivation. (Fara)

Shorter videos seemed not only to help students to pay more attention to each piece of content, but also to memorise better. This can be seen from the response below:

The use of multimedia actually helps me to memorise the content better. I do not like to read too many words actually. And what’s more, I can re-scan the trigger image as many times as I wish. (Atia)

Another opinion on AR was that it allows students to spend their own time to digest the information presented in each AR material provided. The promotion of self-directed learning can be seen from participants’ answers. The use of this approach seemed to be appreciated by the students, as an alternative to open discussions or lectures. Anne, for example, elaborated on how she views AR:

It [AR] is interactive, and gives us the freedom to spend our own time to watch all the multimedia given. I love it because it is something new to me. I mean Aurasma is like magic. It integrates a photo and a video and your mobile phone becomes the medium to make it happen! (Anne)

Using AR can actually fulfill our individual needs. We have different paces or speeds of learning. (Zurani)

Meaningful learning can be achieved through satisfying activities and when learners experience the process themselves. While learning to use the Aurasma app, students were also given a chance to do a hands-on activity in which they created their own trigger images and videos as overlays prior to developing their actual projects. All the students had to demonstrate their Auras (videos overlayed on trigger images created using Aurasma software) in one of the tutorial classes. Hands-on activities were mentioned by the students as what made AR interesting and satisfying, for example:

The most important impact on me when I learn to create AR is the fact that we had to experience a hands-on activity. We needed to do everything from scratch, from planning to developing and uploading. The best feeling is when the product runs well. That is the highest satisfaction [laughs]. I think there should be more projects like this using AR. (Aryan)

Another feature of AR is its ubiquity, which was mentioned by 41.66% of the participants. They appeared to appreciate the fact that they can use AR anytime and anywhere they wished. For example:

Because AR uses mobile apps, it can be used anywhere, anytime. Ubiquitous, that’s the word! (Amirul)

AR in a way can replace a one-way teaching and learning process. No boredom. (Iza)

Although students found the use of AR motivating, interesting and beneficial for learning, a few students mentioned that AR was also challenging. For example:

Developing an AR product means we have to do lots of things. First, we have to decide on a topic. Once we have the topic, we then search for related information. Our group project is on social media. So it is quite a tricky process. We hardly sleep at night. The main challenge for me is to be creative in making our videos, and at the same time we have to design the trigger images. If it is not interesting enough, people might not want to scan it. But after we manage to complete the work, it is really satisfying. (Noni)
3.2. Students’ experiences in developing their own AR projects

In addition to exploring students’ views of AR, this paper also seeks to study students’ experiences in developing their own AR projects. As mentioned above, students in this study were required to develop their own AR projects as part of their course assessment. None of the students involved were aware of the existence of AR prior to this course, and none had experienced using the application before. So as to accomplish their group task, all the students had to do a hands-on activity to create their own Aura. They were given four weeks to develop their AR project. Throughout the process, they had to work closely in their group and reflect on their own work. The process required them to brainstorm ideas, discuss their work and find the best solution to any problems that developed. As indicated in Table 2, four main themes emerged: collaboration, creativity, critical thinking and communication.

Table 2: Students’ experiences in developing their own AR projects

<table>
<thead>
<tr>
<th>Themes</th>
<th>Sub-themes</th>
<th>Number of respondents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration</td>
<td>Consensus on what to do</td>
<td>23</td>
<td>95.83%</td>
</tr>
<tr>
<td></td>
<td>Allocating tasks</td>
<td>15</td>
<td>62.5%</td>
</tr>
<tr>
<td></td>
<td>Editing work</td>
<td>9</td>
<td>37.5%</td>
</tr>
<tr>
<td>Communication</td>
<td>Giving and taking</td>
<td>24</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>Brainstorming</td>
<td>15</td>
<td>62.5%</td>
</tr>
<tr>
<td></td>
<td>Communicating ideas to the audience</td>
<td>9</td>
<td>37.5%</td>
</tr>
<tr>
<td>Creativity</td>
<td>Exploring new approaches</td>
<td>23</td>
<td>95.83%</td>
</tr>
<tr>
<td></td>
<td>Selecting themes</td>
<td>7</td>
<td>29.16%</td>
</tr>
<tr>
<td></td>
<td>Learning from others’ examples</td>
<td>5</td>
<td>20.83%</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>Being critical and reflective on what</td>
<td>19</td>
<td>79.16%</td>
</tr>
<tr>
<td></td>
<td>they had done</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Problem solving</td>
<td>18</td>
<td>75.0%</td>
</tr>
<tr>
<td></td>
<td>Arranging ideas / content</td>
<td>10</td>
<td>41.66%</td>
</tr>
</tbody>
</table>

3.2.1. Collaboration

The overall process of developing an AR project required collaborative effort. 95.88% of the participants found that a lot of collaborative elements were present. Once they received their topic, the students had to brainstorm their ideas and agree on certain things before they proceeded with the next stage of development. Based on the responses given, the students were aware that they were involved in teamwork from the beginning of the process to the very end. For example, after deciding on a certain theme, they had to create trigger images and videos before being able to upload them to Aurasma. The collaboration occurred during all phases, from forming brief ideas, selecting designs, developing videos, to editing. Some responses included:

Obviously, this activity [the development of AR] requires collaborative work among us. We started with brainstorming ideas, selecting a suitable theme, and deciding who was going to do this and that. (Zaidan)

We really learned through trial and error. But it did not demotivate us. I myself became more eager to make sure that our AR works! (Zuraida)

What is exciting about the AR project is that we worked in a team. Everybody was so excited about AR and that made us want to give our best to produce a satisfying product! We split our tasks according to the storyboard. We were lucky that Google Presentation is there! So we didn’t have to meet up physically to complete the storyboard [students used Google Presentation to create their storyboards] (Hanif)
3.2.2. Communication

Another theme that emerged from the analysis was communication. Connected closely with collaboration, students mentioned how they were engaged in communication activities with their peers. When they talked about communication, it did not only involve the skill of expressing ideas effectively to others, but the students also mentioned give and take processes as part of their communication:

We communicate a lot about AR. I would say that this project not only scaffolds our communication skills among the group members, but also how to communicate out ideas to our users. That part is more challenging I think. (Zuraida)

This task is meaningful to me personally. As a pre-service teacher, I have to master communication skills. I mean, how to explain concepts in a very accurate and effective way. I am in love with AR. I will surely use it as part of my teaching materials. (Noni)

Nine students also highlighted communication skills with audiences, in the form of video and animation. For example:

AR is like a medium of communication. You provide the videos in a sequence and the users will go through them one by one. I wish that we had had more time to create an online quiz, but we had no time for it. (Dahlia)

3.2.3. Creativity

It is undeniable that the development of AR requires creativity, not only in designing the illustration for trigger images, but more importantly in video production. The creativity aspect was mentioned many times by the participants. In the process of completing their group task, students were given the freedom to think of the theme of their product, as well as the depth of the content they would cover. This task was challenging for them as they needed to conceptualise their product and think of its possibilities. These aspects can be seen in the following example responses:

Creating AR really challenges our creativity. We explored many potential approaches actually, and finally we decided to use the one we have presented today. Infographics are the best way to convince users as it takes less time, but the video is something that we think makes the difference. (Mike)

The AR presentation was something that we were looking forward to, although I cannot deny that we were so nervous … we were not that confident whether the overlay videos would play accordingly when others scanned [the images]! But the most important thing that I experienced through this task is … it taught me to think more creatively. (Azura)

This is the best project we have ever had since we become students here! I think AR requires not only ICT skills but more on how to be creative and selective, but at the same time we also have to be precise in selecting which points to be highlighted in sequence. (Dahlia)

To overcome a lack of creativity, students cited learning from others’ examples, such as watching videos via YouTube:

What was the most challenging aspect in developing AR was creativity. As we could not think of many creative ways, we decided to view videos on YouTube and learn from those examples. We chose the best and then we tried to produce a somewhat similar video. (Mimi)
3.2.4. Critical thinking

Critical thinking is defined as a cognitive process, a purposeful self-regulatory judgment that includes cognitive skills such as interpretation, analysis, inference, evaluation, explanation, logical thinking and problem solving (Perry, 1981). The analysis shows that the students also talked about how they learned to develop their critical thinking throughout the process of completing their AR projects, and this involved their judgments about their own work, for example:

It is a process in which we need to ‘judge’ our product critically. Is it understandable? Is it interesting enough for users? Does it achieve our objectives? Those are the things that we have to critically think about. (Hanif)

It is like ‘what if’ thinking … you know what I mean … we have to wear that kind of ‘hat’. (Zuraida)

Students mentioned that they learned through trial and error, through which they developed better skills in AR development:

We really learned through trial and error. But it did not demotivate us. I myself became more eager to make sure that our AR works! (Mimi)

In addition, the students mentioned how they had to be problem-solvers and to work with objectives - a good characteristic of an instructional designer. For example:

This project helps me to be more objective. Our lecturer also reminds us that we have to always go back to our objective. We are taught how to identify problems, and what needs to be done to solve the existing problem. We learned how to fix things on our own. (Mahadi)

41.66% of participants mentioned that they learned to use their cognitive skills more effectively to arrange the content so that the information related to their topic would help their audience to grasp the concept more meaningfully:

It’s not only about creating a good design for trigger images, but also the skills to arrange the content so that it will ease our users to follow the idea, and at the end of it they will learn something about the topic (Dahlia)

There are many things that need to be explained, but you have to do it in chunks. We are used to developing a long video, like 15 minutes or so … but for this project we have to split them into shorter videos. We have to think carefully about the content and the arrangement of the videos themselves. (Suraya)

4. Discussion and Conclusions

The overall findings show that students had positive views of the use of AR as part of their learning. Using AR was valued as a fun activity and one that helped learners to memorise better. These findings are in line with Vincenzi et al. (2003) and Valimont et al. (2002). Students also reported that they were motivated and interested to learn about new topics using AR. These findings are consistent with Juan et al. (2008) and Liu et al. (2009). With the use of their own smartphones to access to the overlay videos, students saw how convenient it is to learn using AR. In addition, they could use their own time to re-scan the overlay videos as frequently as they wished. This is also mentioned in Wei et al. (2015). Nevertheless, despite the fact that students demonstrated positive views of the use of AR for
learning, when they had to develop their own AR projects, many of them saw it as a challenging task. However, the challenges they faced did not demotivate them from their tasks.

When asked about their learning experiences throughout the process of developing their AR projects, students gave varying answers. It was clear that the process of developing an AR project had built their collaborative skills, as working in a team needed such skills to make the project successful. It seemed that the students not only learned collaboratively when they used AR materials together, as found in the research of Freitas and Campos (2008) and Radu (2014), but also that they worked collaboratively when they developed the AR material themselves. It was also revealed that in addition to collaborative skills, the students also experienced an increase in their communication skills and creativity.

The low ability of students, particularly in higher education settings, to demonstrate critical thinking has been identified as an issue (Khalid et al., 2015; 2016). This has been believed to be due to a lack of tasks that stimulate their critical thinking. The findings from this study indicate that the task of developing an AR project can inculcate students with critical thinking abilities, including the cognitive ability to interpret, analyse, evaluate, explain things effectively (Perry, 1981), reflect, criticise (Khalid et al., 2015; 2016) and solve problems (Rimiene, 2016).

The emerging themes of collaboration, communication, creativity and critical thinking are dimensions of twenty-first century skills. From the findings of this study, it can be concluded that the integration of AR elements into learning activities can promote these skills among students, and leverage educational experiences, particularly when they are asked to develop AR materials. The findings also suggest that the use of AR should be encouraged among tertiary students as an effective way to construct learning experiences (Radu, 2014), as they will experience a new way of learning that is dynamic, interactive, and allows them to control their education (Chen, 2006). This study also contributes to suggesting how educators can maximise the potential learning benefits of and generate guidelines for designing effective educational AR experiences.

References


