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UNDERSTANDING VIETNAMESE PRESERVICE TEFL TEACHERS' TPACK DEVELOPMENT WITH DESIGN-BASED LEARNING VIA REFLECTIVE LEARNING

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Abstract: *The present study is aimed at understanding pre-service teachers' Technological Pedagogical and Content Knowledge (TPACK) development with Design-based Learning (DBL) in a blended learning course on Technology enhanced learning. Reflection was employed to probe the preservice teachers' TPACK development and the complex interrelationship between the seven knowledge components. Through content analysis of the participants' reflective journals and thematic analysis of their interviews, the findings revealed that there was certainly some evidence of growth in some of their TPACK components although content knowledge, technological content knowledge and pedagogical content knowledge were still limited. Both Design-based Learning environment and the reflective tool have proven to be useful platforms for the preservice teachers to enhance their learning experiences of technology use, and their willingness and confidence to apply what they learned in their future teaching practice.*

Keywords*: Preservice TEFL teachers, TPACK (Technological Pedagogical and Content Knowledge), Reflection, Design-based Learning (DBL), Technology Use*

Introduction

The past few decades have witnessed the widespread adoption of information and communications technology (ICT) in different aspects of society, particularly in the field of

education in both developed and developing countries (Nguyen & Le, 2011, Peerarer & Van Petegen, 2012). In certain countries, ICT is seen as a catalyst for the education and training transformation and the improvement of teaching and learning practice (Chowcat, Phillips, Popham & Jones, 2008). In the case of Vietnam, a developing country that is heavily reliant on ICT to spearhead transformation in its educational development, the use of technology has presented both opportunities and challenges. The question of what teacher preparation programs should be in order to have technologically competent teachers after graduation is never easy to answer and requires more research efforts.

A framework that is predominantly seen as a comprehensive framework which itemises the most essential components of knowledge for a teacher in order to effectively integrate technology into their teaching practice is the TPACK framework (Mishra & Koehler, 2006). This framework has become a widely utilised heuristic of some technology preparation programs for prospective teachers (Angeli & Valanides, 2005; Pamuk, 2012). However, the number of empirical research examining teachers' knowledge about technology integration in teaching, especially in Vietnam, is quite rare. Therefore, the current particular study aims to fill this gap and to explore the development of TPACK among preservice foreign language teachers at a large university in Vietnam.

According to Mishra and Koehler (2006) and Divaharan (2011), in order to investigate into and enhance the multidimensional TPACK, Design-based Learning has been regarded as a useful approach to assist teachers to integrate technology into teaching practice effectively. However, limited studies have discussed what principles of DBL contribute to the TPACK development and how and which particular principles can be applied into teaching activities. Therefore, one of the most important aims of this research is to fill in the gap in the literature of utilising DBL principles-based activities for the preservice teachers' TPACK growth.

Recently, various instruments have been employed to investigate preservice teachers' TPACK development including self-report measures (Agyei et al, 2011; Thooptong Kwangsawad., 2016; Augustin & Liliasari, 2017), questionnaires (Bostancıoğlu, & Handley, 2018), performance assessments (Graham et al., 2012; Avidov-Ungar & Shamir-Inbal, 2017), interviews (Ozgun-Koca, 2009; Augustin & Liliasari, 2017) and observations (Suharwoto, 2006; Bustamante, 2017;). Nevertheless, the use of reflection seems to be underused although numerous researchers have mentioned reflection as a way to facilitate preservice teachers' knowledge growth (Dieker & Monda-Amaya, 1995; Reagan et al., 2000). This study, thus, aims to gain a deeper understanding of preservice teachers' TPACK growth through reflection.

The present study involves the examination of the TPACK development among the EFL teacher candidates at a Department of English in a large university in Central Vietnam. In the current research, some reflective activities were integrated into a DBL environment to help preservice teachers foster their TPACK knowledge. Through content and thematic analysis, three questions were addressed as follows:

1. Are there any improvements in the preservice teachers' TPACK after following the technology-embedded DBL course?
2. How did the preservice teachers perceive the technology-embedded DBL course?
3. In what ways does reflection help to enhance the preservice teachers' TPACK?

Literature Review

Understanding Technological Pedagogical and Content Knowledge (TPACK)

In response to the increasing need to have a unified framework for teaching that put effective technology use as core competency, in 2006, Mishra and Koehler introduced a new theoretical framework known as Technological Pedagogical Content Framework (TPACK). This conceptual framework originated from Shulman's early idea of pedagogical content knowledge (PCK) framework (Shulman, 1986, 1987). TPACK has provided teacher educators with a unified framework to reframe teacher's knowledge to integrate technology, pedagogy and content in educational contexts (Niess, 2005).

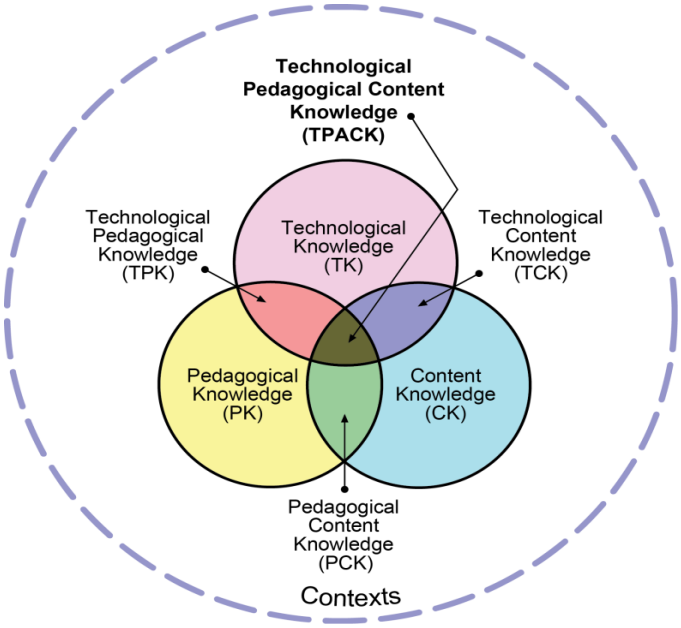

Figure 1. Graphic Presentation of Technological Pedagogical Content Knowledge Framework *(TPACK)*

At the heart of the TPACK framework is "the understanding that teaching is a highly complex activity that draws on many kinds of knowledge" (Mishra & Koehler, 2006, p. 1020). This framework consists of three core categories of knowledge: pedagogical knowledge (PK), content knowledge (CK), and technological knowledge (TK). Combining these three core types of knowledge results in four additional types of knowledge: pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK). Each type of teacher knowledge represented in the framework is briefly described as follows:

- Pedagogical Knowledge (PK) describes the general knowledge teachers have about how to teach and how learning occurs.
- Content Knowledge (CK) incorporates teachers' knowledge about the subject matter to be learnt or taught.
- Technology Knowledge (TK) is knowledge of digital technologies and the skills required to operate them.
- Pedagogical Content Knowledge (PCK) is knowledge of how to combine pedagogy and content in an effective manner.
- Technological Pedagogical Knowledge (TPK) requires an understanding of general pedagogical strategies applied to the use of technology.
- Technological Content Knowledge (TCK) deals with the manner in which technology and content are reciprocally related.

Technological Pedagogical Content Knowledge (TPACK) is an emergent form of knowledge that goes beyond all three components (content, pedagogy and technology). TPACK is the basis for effective use of technology in teaching and a condition for efficient adoption of ICT in the teaching and learning process (Koehler & Mishra, 2009). This knowledge is different from knowledge of a particular subject and also from the general pedagogical knowledge shared by teachers across disciplines. A better application of TPACK requires an understanding of the representation of concepts using technologies, pedagogical techniques that use technologies in constructive ways to teach content, knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems students face; understanding of students' prior knowledge and to develop new epistemologies or strengthen old ones (Koehler & Mishra, 2009). Therefore, teachers who possess TPACK consider and adopt technology as a part and improvement of their pedagogical methods in teaching content.

Design-based Learning (DBL) and TPACK

According to Koehler and Mishra (2005a, 2005b), in order to facilitate teachers' TPACK development, designing authentic teaching situations has been suggested as a promising instructional approach. Design-based Learning has been impacted by numerous theoretical traditions including reciprocal teaching, case-based reasoning (Koehler & Mishra, 2005a), problem-based learning (Han & Bhattacharya, 2001; Koehler & Mishra, 2005a), goal-based scenarios, project-based inquiry science, anchored instruction, knowledge integration and cognitive flexibility theory (Kolodner et al., 2003). Another theory worth a mention is constructionism in which the potential of DBL activities were suggested. Other scholars have also highlighted the important role of complex, self-directed, personally motivated and meaningful design projects for students (Harel & Paper, 1990; Blumenfelt et al, 1991; Kafai, 1995). In addition, DBL is supported by problem-based learning's research and theory. In such approaches, authentic learning opportunities are offered to engage students in meaningful tasks to help leverage their prior knowledge (Koehler & Mishra, 2005a). DBL required the students to become a cognitive apprentice, exploring and learning about the problem in the presence of peers and teachers, a facilitator managing the context and helping students to enhance an understanding of the material at hand (Blumenfeld et al., 1991; Savery & Duffy, 1995).

DBL has been widely adopted in a variety of educational context from K-12 classrooms to higher education (Koehler, Mishra, Hershey & Peruski, 2004; Fessakis, Tatsis & Dimitracopoulou, 2008; Pamuk, 2012), from preservice teacher education (Angeli & Valanides, 2009; Chien et al., 2012;) to in-service training (Jimoyiannis, 2010; Prieto et al., 2011).

Koehler and Mishra (2005a) and Chai et al. (2013) emphasized the importance of teachers' design literacy as one of the best ways to promote creative and flexible applications of TPACK. In fact, studies on examining DBL as an approach for fostering the development of TPACK have been found common in the literature. In 2005, in "Learning Technology by Design", Koehler and Mishra introduced the Learning by Design strategy which was illustrated by three practical examples of its use in three different courses. The participants of these studies were graduate students and faculty members who were engaged in authentic design activities around educational technology such as creating an online course, making idea-based videos, redesigning existing websites or web resources. Once the tasks were assigned, participants moved on to the design process when they started to examine how technology, pedagogy and content supported each other and at the same time produced artefacts which were then examined to better understand the complex TPACK nature. Therefore, it can be said that DBL creates a hands-on exploration environment in which

participants engage in actively working on solving the problem such as design technological tools during the process of TPACK development.

DBL activities also offered participants considerable opportunities to gain a more profound understanding of the relationship among content, pedagogy and technology (Koehler et al., 2004; Koehler & Mishra, 2005a). In the process of technology-integrated classroom environment, participants cooperated and helped one another generate, share, test and decide the best solutions to instructional technology problems (Jang & Chen, 2010; Hur et. al, 2010; Koehler & Mishra, 2005a). The close relationship between TPACK and DBL in teacher education contexts is illustrated with an outline of eight principles which enhance preservice and in-service teachers' TPACK development (Figure 1).

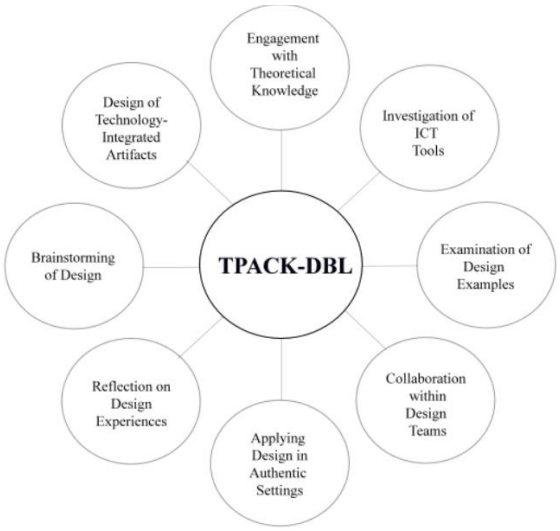

Figure 2. TPACK-DBL Principles (Baran & Uygun, 2016)

According to Baran and Uygun (2016), the first principle, the brainstorming of design ideas offers learners opportunities to not only consider ideas for lessons and activities but also discover different solutions to technology integration problems. As for the second principle, the design of technology-integrated artefacts, learners can cooperate to decide the best solutions to problems which might be encountered in real teaching contexts, such as in creating lesson plans or online courses. The third principle, the examination of design examples, allows learners to be critical of their own or their partners' work or materials and to gain a deeper understanding of pedagogy, content and technology and how they can be integrated in effective teaching. Regarding the fourth principle, engagement with theoretical knowledge, learners are equipped with important foundation for teaching and designing materials with ICT. The fifth principle, the investigation of ICT tool, puts an emphasis on the potentials as well as the constraints of technologies, which learners need to master prior to designing materials. The six principle, reflection on design experiences, can assist learners in elaborating on their own experiences and assessing their own TPACK growth. As regards the seventh principle, the application of design in authentic settings, learners have opportunities to put their TPACK into practice and understand influences of contextual factors on their teaching process. The eight principle, collaboration within design teams, can help leaners to find out solutions to authentic technology integration problems when working in design teams. For the current study, the technology-embedded course was designed based on these eight principles with an aim to develop the preservice teachers' TPACK.

Reflection in Teacher Preparation and its Relationship with TPACK and DBL

The idea of encouraging reflection in preservice education has gained attraction in recent years. According to Grossman (2008), Ostorga (2006), the encouragement of reflective activities is considered an establishment and crucial part of teacher preparation program. Reflection is a process of self-examination as well as self-evaluation in which teachers and educators regularly do to develop their professional practices (Shandomo, 2010), an interaction of experiences with analysis of beliefs about those experiences (Newell, 1996). It is also described as an interactive process of framing and reframing an issue. Schon (1983) proposed specific questions for reframing problems, such as: Can I solve the problem I have set? Have I made the situation coherent? He also suggested two categories of reflective thought: reflection-in-action focusing on the thought process during an event, and reflection-on-action referring to reflection following the completion of the event. Other models of reflection introduced later (Pugach, 1990; Smith & Lovat, 1991) have also considered time frames in which reflection takes place in order to make changes to behaviour. While Field and Latta (2001) emphasized the role of teacher education in ensuring the preservice teachers being open to experience, McLeskey and Waldron (2004) found out alterations in teacher preparation can help to narrow the gap between knowledge and practice.

The value of reflection has been emphasized in response to attacks on the sufficiency of teacher preparation. When teachers reflect on their in-class experience, they describe, analyse these events and thus, construct their own theory about teaching. Such reflective thinking helps educators "to act deliberately and intentionally rather than randomly and reactively" (p. 103, Shandomo, 2010). Moreover, according to Francis (1995) and Spalding et al. (2002), journal writing is a popular pedagogical strategy to elicit reflective thoughts from teacher candidates. In this study, the candidate teachers were offered multiple opportunities for reflection through which the development of different components of TPACK knowledge can be clearly observed.

In this research, the use of reflective activities offers preservice teachers' opportunities to articulate their DBL experiences and thus, foster their interpretation of their technology use experience and construct their practical theory about using technology for instruction. Therefore, in order for teacher candidates to develop TPACK in new contexts, it is important for them to have opportunities to reflect on their teaching experiences so that they can "extract and clearly articulate what they have learned" and make "those articulations rich in the right ways" (Kolodner, 1997). During the process of articulating what they have experienced in DBL, preservice teachers have to encounter and deal with the complexity of technology use in authentic teaching environments, through which promoting a deeper understanding of the complex and dynamic relationship among different knowledge components in TPACK.

In summary, it can be suggested that reflection can be an effective strategy for preservice teachers to interpret their technology use experience in DBL and thus construct their understanding of TPACK.

Methodology

Research Setting

The study involved 35 third-year students from a language university in Central Vietnam. The participants were at that time taking a four-year BA in Teaching English as a Foreign Language (TEFL) program. Their ages range from 21 to 24 years of age.

The technology-based course on "Technology in Teaching" for preservice teachers at a higher institution in Vietnam was designed with some adaptations and based on the eight TPACK-DLB principles (Figure 2).

Table 1. The Design of the Course with TPACK-DBL Principles

Steps	Applications in Current Course	TPACK-DBL principles
1.	- The instructor modelled the major activities or demonstrated the effective use of technology to help preservice teachers gain some understanding of what is required and expected from them. - The preservice teachers were assumed to possess limited real-world teaching experience, which means their knowledge about teaching and learning with technology is from their own learning experience as students or from their observations of their teachers. Therefore, it is important to help them construct their own knowledge or connect between their old and new experience so that they can apply them to new situations. - The preservice teachers will actively participate in these learner-centered model lessons and, to some extent, compensate for their lack of previous teaching experience. - Some readings will be provided to help preservice teachers gain a proper understanding of the issue in this phase.	(1) (4)
2.	- The preservice teachers drew some ideas about how to design the artefacts, plan them, share them with other classmates and received feedback from their team and the instructors. Depending on the tasks' or projects' requirements, the preservice teachers had to consider, select, analyse and make decisions about their audience, content, instructional strategies and technology.	(1) (3) (5) (8)
3.	- The preservice teachers began to design and construct their instructional products based on their planning in the previous phase while continuing to receive feedback from instructors and other class members.	(2) (3) (5) (8)
4.	- The preservice teachers were required to analyse data collected in the previous step, examine scientific issues related to the design and testing process. However, in order to facilitate the data collection from the participants who were new to scientific research and technology integration, various forms of written report reflections were provided to help them articulate the rationale of their designs and how they could bring the most desired outcomes.	(3) (6)
5.	- Preservice teachers presented and shared their artefacts and findings. - Except for the project, the artefacts (tasks) for each session were tested in group or pair due to time constraint. In course project, the preservice teachers would have opportunities to test their products in front of their whole class.	(7)

To operationalize the TPACK-DBL principles within a technology-based course entitled "Technology in Teaching", some adjustments were made to the syllabus of the course. The 12-week course was divided into 5 sessions which included four main introductory topics on technology application, namely (1) Microsoft Word and PowerPoint; (2) Moodle; (3) Manage Quizzes in Moodle; (4) Assistive Technologies. The first three sessions lasted three weeks each, the fourth lasted two weeks leaving one week for the presentations of the course projects. The main reflective activity in this study was to get the preservice teachers to write

reflective journals after each learning session. In order to facilitate their writing reflective journals, some guiding questions were given as follows:

1. Summarize what you learnt today about technology integration. What was the most interesting?
2. What instructional and classroom management strategies did you recognize?
3. How might you apply what you learnt in class today for your students in future classes?
4. Are there any queries or comments would you like to ask or share?

Data Collection

Data were collected from the 35 participating preservice teachers who attended a course on "Technology in Teaching". Throughout the course, the researcher collected students' reflective journals on a weekly basis and then used both quantitative and qualitative data analysis to identify significant themes to address the research questions. 35 sets of reflective journals were collected after each session and the course project. At the end of the course, focus group interviews were employed to help elicit information from several individuals as well as to obtain perspectives from specific people (Creswell, 2007).

Data Analysis

Nvivo, a qualitative research and content analysis software, was used to analyse the reflective journals. Content analysis is a flexible research approach which can be applied to a wide variety of text sources and has also been used to analyze teachers' technology integration experiences. The authors followed the steps in content analysis to analyze the preservice teachers' reflective journals including identifying samples of textual materials, developing a protocol and train coders, analyzing and describing the target variable. TPACK constructs defined by Mishra and Koehler were used as the protocol to classify the preservice teachers' experiences. First, the researchers and a coder used two sets of reflective journals to create coding examples for identifying the TPACK constructs (Table 1).

Table 2. TPACK Coding Categories

TPACK Construct	Coding Example
TK	The teacher gave a lecture on creating PowerPoint slides to increase visual impact on audience.
PK	The lesson today is about how to use Moodle to organize and maintain classroom management.
CK	There are different ways to ask for permission or to give an invitation.
TPK	The Text-to-Speech software can enhance the effectiveness of teaching pronunciation.
TCK	Today I know about assistive technologies that can be effectively integrated for a variety of subjects.
PCK	The teacher explained how to choose the best teaching strategy to guide the learners' learning
TPACK	We exploited a number of websites to enhance the quality of our teaching practice and the amount of knowledge the students obtain.

To ensure coding validity, each reflective journal was coded independently by the researchers and the coder. After that, they compared their coding's, they then discussed to resolve the coding differences. The Nvivo software was used to calculate the final inter-rater agreement between the researchers and the coder. The following table presents the Cohen's

Kappa values on the seven constructs. As can be seen from the table, all the values are above 0.90, which showed an almost perfect agreement.

Table 3. Inter-rater Agreement

Construct	CK	PK	TK	TPK	PCK	TCK	TPACK
Kappa values	0.93	0.92	0.97	0.91	1	0.96	1

For the second research question of how reflection helped the preservice teachers develop TPACK, thematic analysis was employed to examine the interview data. Thematic analysis provides "an easily interpretable and concise description of the emergent themes and patterns within a dataset, usually as the foundational phase of interpretation" (Braun & Clarke, 2006). Throughout this process, the researchers identified key themes to analyse and examine the preservice teachers' opinions on their reflective activity.

Findings and Discussion

Research Question 1: Are There Any Improvements in Preservice Teachers' TPACK After Following the Technology-Embedded DBL Course?

In order to answer this question, it is important to determine the coverage of each TPACK construct in their reflective journals, which referred to its proportion coded.

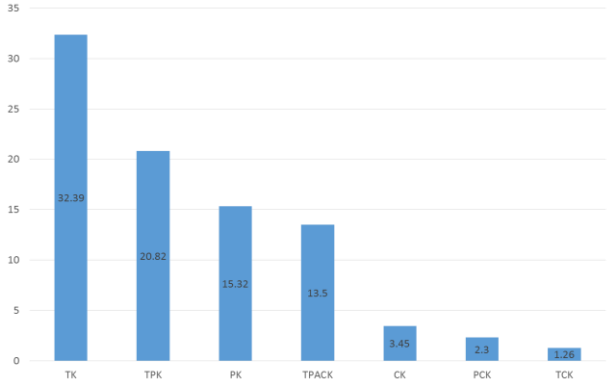

Figure 3. Coverage of each TPACK Construct in Reflective Journals

As can be seen from the bar chart, the preservice teachers' TK, TPK, PK, TPACK, CK, PCK and TCK increased to different extent after attending the course. While the constructs with high coverage include TK (32.39%), TPK (20.82%), PK (15.32%) and TPACK (13.5%), other constructs - CK, PCK and TCK had lower coverage with 3.45%, 2.3% and 1.26% respectively. Accordingly, the development of each TPACK construct can be identified through its coverage in the participants' reflective journals. The knowledge components with higher coverage indicate the preservice teachers' awareness growth in these areas. Therefore, it is evident that the preservice teachers in this study proved that they could articulate their experiences and understanding of TPACK through quite detailed description of their technology integration, particularly in the categories of TK, TPK, PK and TPACK. This finding is very much in keeping with the literature that DBL approach offered by Mishra and Koehler (2006) led to considerable changes in the TPACK development in a number of studies (Jang & Chen, 2010; Koehler et al., 2004; Alayyar, 2011). However, the level of different TPACK components growth was not the same. This could be in alignment with the literature that "developing TPACK is a multigenerational process, involving the development of deeper understandings of the complex web of relationships between content, pedagogy and technology and the contexts in which they function" (Koehler et al., 2007).

Moreover, Harris et al. (2010) also wrote in his research that "TPACK, like all types of teacher knowledge, is expressed in different ways and to different extents at different times, which different students, and in different contextual conditions". For instance, Agyei and Voogt's research (2012) and Bahcekapili (2011) revealed greater improvement in teachers candidates' TK, TPK, TCK and TPACK while Pamuk (2012) and Guzey and Roehrig (2009) identified a lack of PK leading to the participants' inadequacy in PCK and TPK.

Research Question 2: How Did The Preservice Teachers Perceive The Technology-Embedded DBL Course?

Analysis of the preservice teachers' reflective journals and interviews revealed that most of them took a positive attitude towards the DBL course. According to Mishra and Koehler (2006), DBL approach offered a hands-on exploration environment in which technology integrated learning tools were designed in the process of TPACK growth. As Liam pointed out,

"I was kinda confident with my technology skills at the beginning of the course, so the name of the course did not impress me much then. However, a variety of activities like lesson plan designing, the final projects, presentations made me feel like I need to be more active and of course a lot of practice was required if I wanted to integrate technology into my teaching practice well."

Some other students commented that they became more confident and independent in constructing technological artefacts to solve problems related to technological application in authentic instructional contexts. As Mai, one of the participants, mentioned,

"What a great feeling when now I know how to engage myself in the real lessons which I can design, revise and present myself. It can be hard to express in words here but I feel like I gain more experience and skills needed to deal with technological problems and learn what is best for my future students".

Their sharing concurs with Koehler and Mishra (2005a) who posited that these teachers go beyond thinking of themselves as being passive users of technological tools and start considering themselves to be "designers of technology" in order to achieve their teachers goals.

Moreover, some preservice teachers also said that this course provided them with opportunities to connect theory with practice, particularly the design activities helped them to improve the knowledge of technology integration as well as experiences to apply them. One participant, Hung, commented on one of the contributions of the DLB course,

"I had several discussions with my lecturer and classmates before preparing a lesson plan or a presentation. We had to compare different solutions in terms of the teaching approach, the content of the lesson and technological tools and of course, mistakes were unavoidable and we even had to start again a couple of times. However, I found it useful and gained a lot of benefits while trying to organize different steps in the tasks/projects and thus, learned how to teach more effectively."

These findings above are in line with the current research which claimed that such design activities greatly contributed to the development of TPACK (Timur, 2011; Chien et al., 2012; Graham et al., 2012). It is also clear that some TPACK-DBL principles were quite explicit in this case including principle (1), (2), (4), (7) and (8).

During the course, the preservice teachers were also required to be critical of different technological tools and elaborate how they could fit the content and pedagogy in the lesson plans, evaluated them and had to deal with new technologies. As Luna said, *"Sharing and planning different technologies opened my mind, I especially learnt how to use and analyse the tools that I haven't known before in the course. It could take time to consider which technologies were suitable for specific lessons and we had to be very careful."* This helped enhance their technological competence, which fits the third and the fifth TPACK-DBL principle including examining design examples and the investigation of ICT tools.

Research Question 3: In What Ways Did Reflection Help To Enhance The Preservice Teachers' TPACK?

Reflection is not merely a main tool to elicit the data from the participants in this current study but also one of important steps throughout DBL environment (Han & Bhattacharya, 2001). Therefore, this activity has a close relationship with the DBL-embedded course in determining the TPACK development.

First, reflection helps the preservice teachers to think about what they had done in the classroom, recalled ideas learned, and most importantly, examined the relationship of teaching with technology. For example, Sam said,

"While writing the journals, I often tried to remember the most important parts of the lesson. I also wrote down my opinions about the lectures, what I liked most about the classmates' answers about the issue discussed. I felt like I learnt it the second time, especially the fact that the technological issues seemed easier for me".

Quinn et al. (2010) also supported this view saying that reflection was regarded as the means by which teacher candidates became problem-solvers and met the intellectual challenges of the classroom.

Second, reflection appears to help the preservice teachers become more confident and more willing to integrate technology in their teaching practice. This is in line with the findings of several researchers on reflection such as Hayden (2010), Lee (2010) who underscored the role of this activity on preservice teachers' gaining more belief in their teaching abilities. As Pete said,

"My first few journals were quite simple. I just wrote about what we did in class, what the technology was introduced that day. I was not interested in sharing much technological aspects because I did not think I was good enough then. However, as the course was coming to an end, I loved to write more about my technology use experience".

Reflection also appears to encourage the preservice teachers to contemplate how to apply what they learnt from the course into their future teaching practice. As Linh said, it really took her some time to finish a reflective journal because she usually thought about how she could customize a technological tool to suit her students. Mai had the same opinion that she often made comparisons about different applications and software and decided which was better for EFL learners in her reflection.

To sum up, it is evident from the participants' reflection and interviews that reflective activities were useful to help preservice teachers develop different components of their TPACK, especially boosting their confidence and willingness to integrate technology in teaching practice. Moreover, when reflecting on their experiences during the course, they

had a chance to think about how to take advantage of different technological tools to teach their future EFL student in an effective way.

Conclusions, Limitations and Implications

The study aims to investigate whether DBL environment led to preservice teachers' TPACK development, how the preservice teachers perceive its effectiveness and how reflection supported them in constructing TPACK. Using content and thematic analysis of the participants' reflective journals, evidence of TPACK growth was revealed quite sufficiently and vividly. This means that engaging students in design activities in DBL environment helps them enhance their connection between theory and practice in technology integration, their confidence and proficiency in technology use. Moreover, in an attempt to identify a theoretical framework for teacher education programs, the study identified and further asserted DBL principles as a useful way to facilitate the preservice teachers' understanding and practice in technology integration. Therefore, the current research plays an important role in addressing the gap in the literature of DBL implementation as an approach for TPACK growth.

What is more, reflection has proved to be a useful way to help the preservice teachers to gain a better insight into the integration of technology into teaching practice and the application of what they have learnt in future classrooms. Nevertheless, the positive effects found in this study with the pre-service teachers TPACK development should be viewed with caution, as the findings may be specific to the context of the current study. Further study could examine similar sets of data in other context for a more considerable insight into the complex nature of TPACK.

In the current study, it can be clearly observed that while the pre-service teachers' reflections showed a high percentage of TK, TPK, PK and TPACK, those of CK, TCK, PCK were rather limited. Such findings could be attributed to TPACK's complex nature as discussed earlier but more research should be conducted to investigate into why and how these different components vary over the course.

The study also suggests some lessons for teacher trainers in terms of creating an effective DBL environment for preservice teachers to develop their TPACK. First, it is essential to insert more authentic examples and learning materials as they play an important role in motivating the pre-service teachers to reflect what they have learnt or experienced to related topics which are taught in class. In doing so, they can be encouraged to apply what they have learnt to deal with instructional problems which can happen in their future teaching context.

Finally, since DBL module used in this research was found to have positive influence on students' TPACK growth, at faculty level, its principles can be applied in technology integration courses to contribute to the development of teacher candidates' technology integration in teaching practice and also in in-service training workshops for current teachers' TPACK.

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