Pre-service Teacher Education in 21st Century: Constructivist Learning Environment Model for Technology Integration to Foster Creative Instructional Design in Teacher Education

Wasant Atisabda, Ophat Kaosaiyaporn, and Nisreen Prompalad
Department of Educational Technology, Faculty of Education, and Research Center for Educational Innovations and Teaching and Learning Excellence, Prince of Songkla University, Thailand
Email: {vassan.a, ophat.k}@psu.ac.th, nisreen.pr@gmail.com

***Abstract*—The purpose of this study was to design and develop the constructivist learning environment model to enhance technology integration and to foster the creative instructional design in teaching and learning. The target group consisted of 20 second year pre-service teacher students majoring in Educational Technology and Communications who studied the Technology Integration in Education course, Faculty of Education, Prince of Songkla University, Thailand. The focus group of experts in instructional technology and instructional system design was conducted to identify the new learning environment based on constructivist to foster creative thinking related to technology integration in teaching and learning for pre-service teachers. It included the pedagogy innovation, the technology innovation, and the knowledge innovation, which led to the creative learning environment, the innovative curriculum and instruction, and the smart and innovative pre-service teachers. The Constructivist Learning Environment Model for creative technology integration in teacher education was proposed. They included five components – problem base, learning resources, scaffolding, collaboration & coaching, and creation & reflection.**

***Index Terms*—Pre-service teacher education in 21st century, constructivist learning environment, technology integration in education, creative instructional design**

I. Introduction

The 21st century skills are a set of competencies for students to achieve in order to succeed in the new society. It is very important to develop the new pre-service teachers to keep up with changes in society. From 3Rs (Reading, Writing, Arithmetic) to 3Rs+4Cs (Critical thinking, Communication, Collaboration, and Creativity), 3Rs+7Cs (Critical thinking & problem solving, Creativity & innovation, Cross-cultural understanding, Collaboration, teamwork & leadership, Communication, information & media literacy, Computing & ICT literacy, and Career & learning skills), and currently Prime Minister Prayuth Chan-o-cha of Thailand made an announcement of 3Rs+8Cs, The eighth C that the Prime Minister made an announcement was "Compassion" which emphasized Morality, ethics, mercy and kindness that Thai students need to have [1]. The Prime Minister also introduced "Thailand 4.0 Policy" to unlock the country from several economic changes resulting from the development in Thailand 1.0 (agriculture), 2.0 (light industry), and 3.0 (heavy industry) and leads the country to prosperity, security, and sustainability. The innovation is very important [1].

Before entering the 21st century, the Thai Parliament passed the National Education Act of 1998 and identified the national education reform for the 21st century, particularly in Chapter 9 Technology in Education, it indicated the vision to reform education and to promote technology implementation in education [2].

In addition, "E-Education" and "Smart Learning" were announced by Thai Government in the Second and Third National Framework of Policy & Information Technology to reform the educational practice at all levels of education in the nation. In year 2000, Thai Government made an announcement of Thailand Vision toward a Knowledge-based Society, which we called the ICT-2010 Plan (2000-2010). It included E-Government, E-Commerce, E-Industry, E-Education and E-Society [3]. In year 2010, the Government introduced the third National Framework of Policy & Information Technology, which we called the ICT-2020 Plan (2011-2020). It leads to SMART Thailand 2020. It made more progress to integrate technology innovation in all aspects of the country development. The Government set the policy to develop ICT Human Resource and ICT work force, ICT infrastructure across the country. It led the Nation to Stronger Economy (including Smart agriculture and Smart services), Social Equality (including Smart health and Smart learning), Environmental Friendly (Smart environment (ICT for green and green ICT) [4]. Under this policy, E-Education and SMART Learning were emphasized for education at all levels -- the formal

Manuscript received March 4, 2018; revised August 10, 2018.

doi: 10.18178/ijlt.5.1.66-70

education, non-formal education, and informal education.

Moreover, the Government introduced the National Education Standard in 2003 and set three National Education Standards including Standard 1 – Characteristics of Thai as national and global citizen with skillful, good and happy, Standard 2 – Framework for Educational Management with emphasis on student-center development and school-based management, and Standard 3 – Framework to create Learning Society & Knowledge Society – to create the meaningful learning as well as strong learning resources. In each educational standard, the technology innovation plays important roles to foster the quality of education in the nation. [5].

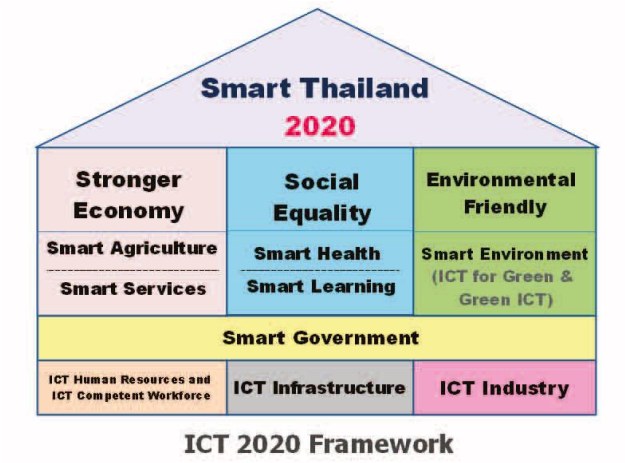

Figure 1. SMART Thailand 2020 (National Electronics and Computer Technology Center of Thailand. Policy framework for information technology from 2010-2020. Bangkok: National Science and Technology Development Agency Ministry of Science Technology and Environment. 2010)

In the Teacher Education practice, Technology standards were included in the Professional teacher education and curriculum for teachers, and educational personnel curriculum for educational supervisors, educators, and educational administrators. Therefore, it is very important for the teacher education institutes to support changes in teacher education and initiate and implement the innovative to develop the pre-service teachers to serve the nation in 21st century [6].

In the 2nd decade of 21st Century, Professor Vicharn Panich, M.D., the well-known and prominent educator of Thailand urged Thai society to work harder to reform Education, teaching and learning in 21st Century in Thailand. [7]

Atisabda and Atisabda proposed 3 models of educational technology in teacher education program: (1) Single educational technology course model, (2) Multiple educational technology courses model, and (3) Technology across curriculum model [8].

It is obvious that the teacher education reform is vey essential to develop the new teachers for the new society. The new learning environment is created to foster the pre-service teacher in the 21st century from the traditional professional practice to the innovative professional practice.

II. Purpose of the Study

This study aimed to design and develop the constructivist learning environment to enhance the pre-service teachers to integrate technology innovation in creative instructional design.

III. Research Design

The design framework of constructivist learning environment was synthesized based on theoretical framework as follows: Enabling context [9] (Hanafin, 1999) as Problem base, the supporting cognitive equilibrium based on cognitive theories as Resources [9], [10] (Hanafin, 1999, Jonassen), 1999), the enhancement in constructing knowledge based on both Social Constructivist [11] (Vygotsky, 1925) as Collaboration and Cognitive tools [10] (Jonassen, 1999) as Cognitive tools, and the support and enhancement for constructing knowledge as Scaffolding [9] (Hanafin,1999), and Coaching and modelling as Coaching tool.

The design and development research was implemented [12]. The target group included ten experts in instructional technology and instructional design for the focus group of Education in 21st Century, twenty pre-service teachers majoring in Educational technology and communications (Faculty of Education, Prince of Songkla University) for the experiment group. These students were studying the course of 263-312 Technology Integration in Education. Three experts were assigned to assess the constructivist learning environment to enhance the pre-service teachers to foster technology integration in creative instructional design as indicated:

1. The Constructivist Learning Environment Model to support pre-service teacher students for technology integration in teaching & learning.
2. The rubric for evaluating the pre-service teachers' technology innovation based on constructivist learning environment.
3. The assessment of Constructivist Learning Environment Model by 3 experts.

IV. Data Collection and Analysis

The researchers designed and developed the constructivist learning environment to enhance the pre-service teachers to foster technology integration in creative instructional design. The data were collected and analyzed as follows:

1. The expert focus group on Education in 21st Century, and Constructivist Learning Environment. The data were collected by the researchers and analyzed by analytic description, interpretation and summarization.
2. Based on the focus group and the theoretical framework, the researchers developed the Constructivist Learning Environment. Then, three experts evaluated the model.
3. The researchers guided and coached the pre-service teachers how to implement the model for teaching and learning with technologies.

4. The pre-service teachers submitted the innovations based on Constructivist learning environment, which were evaluated by the rubric.

V. Research Findings

The research findings were presented as followings:

1. Education and Pre-service teacher education in 21st century were based upon the literacy for 21st century of 3Rs & 8Cs, the technology integration in teacher education in 21st century, in which it was indicated that technology integration in classrooms leading to conclude that technology integration is not about the technology, it is related to teaching and learning. The integration of technology tools into the curriculum and classroom pedagogy is becoming an inseparable part of good teaching performance [13].

2. The constructivist included the cognitive constructivist and the social constructivist. The Constructivist learning environment (CLE). According to David H. Jonassen [10], "Learning is to construct knowledge individually and/or socially based on learners' interpretations of experiences," Based on the CLE, the problem drives the learning rather than acting as an example of the concepts and principles previously taught. The principle of meaningful learning is to create the ownership of the problem or learning goal. The design framework of constructivist learning environment was synthesized based on theoretical framework as follows: Enabling context as *Problem base*, the supporting cognitive equilibrium based on cognitive theories as *Resources*, the enhancement in constructing knowledge based on both social constructivist as *Collaboration and Cognitive tools*, and the support and enhancement for constructing knowledge as *Scaffolding* and Coaching and modelling as *Coaching tool* [10].

3. The design of constructivist learning environment to enhance the pre-service teachers to foster technology integration in creative instructional design was conducted. Three innovations were developed as the fundamental knowledge and experiences for teacher students as follows:

3.1 Pedagogy innovation for new teacher students to discover, learn, experience and put into practices. The 21st century learning styles and approaches would be presented to students to enhance their professional experiences. The pre-service teachers would be coached how to make use of innovative instructional strategies, such as Flipped classroom, Blended learning, Brain-based learning, or others proposed by students.

3.2 Technology innovation for new teacher students to discover, learn, experience and put into practices. Technology for teaching and learning in the 21st century would be presented. The Learning Management System (LMS), Virtual Classroom, or others which the students want to use them, would be the issues for students to learn and practice.

3.3 Knowledge innovation for new teacher students to discover, create, and put in the knowledge repository (knowledge bank). Knowledge in modern pedagogy and modern technology for 21st century or classroom action research would be installed in this knowledge bank for 21st century teaching and learning.

In addition, the fundamental knowledge of the Constructivist Learning Environment (CLE) was implemented to design the new learning environment for pre-service teacher education.

Figure 2. Pre-service teacher education in 21st century

3.4 The new learning environment is developed based on Jonassen's Constructivist learning environment [10], "learning is to construct knowledge individually and/or socially based on learners' interpretations of experiences." He proposed the constructivist learning environment (CLE) as a set of instructional approaches including

1. Appropriate problem, question, case or project,
2. Related cases or worked examples,
3. Leaner-selectable information,
4. Cognitive tools,
5. Conversation and collaboration tools, and
6. Social/contextual support.

Based on this principle and the focus group of experts in instructional technology and instructional design, the researchers modified and developed the Pre-service teacher Constructivist Learning Environment as described below.

3.5 The Innovative curriculum for pre-service teacher students in 21st century. It can be called technology across curriculum or technology integrated curriculum which could enhance teacher students to implement technology innovation into their professional practices more meaningful. [3]. Technology innovation will be taught not just in Educational Technology course, but the concepts of instructional technology will be integrated in all professional courses. In this study the students were coached and facilitated to integrate technology innovation across curriculum in their teaching and learning.

3.6 The Smart and innovative pre-service teachers. The expected outcomes for this model are to develop the smart and innovative pre-service teachers who can create the new learning environment for their professional practices. All participants in this study were coached and facilitated to

create the smart and innovative classroom.

4. The Pre-service Constructivist Learning Environment for Education in 21st Century. The focus group of experts in teacher education specialized in Educational Technology and Instructional Design proposed the Pre-service Constructivist Learning Environment including 5 components:

1. Problem base,
2. Learning resource,
3. Scaffolding for instructional design and technology innovation,
4. Collaboration and coaching, and
5. Creation and reflection.

This model which was called the "*Constructivist learning environment for pre-service teachers' technology integration model*" can be elaborated as followings:

4.1 Problem base. It is to enhance the pre-service teachers to solve problems related to technology innovation in teaching and learning. Twenty students were divided into 5 groups for their study. They identified the problems and find out how to solve them.

4.2 Learning resources. The learning resources were to provide information to help learners comprehend and solve the problem. This information was online and off-line.

4.3 Scaffolding for instructional design and technology innovation. It included the conceptual scaffolding, procedural scaffolding, and strategic scaffolding. The scaffolding facilitated the learners to solve the assigned problem.

Figure 3. Pre-service teacher constructivist learning environment

4.4 Collaboration and coaching. The collaboration was to support the learners to experiences with experts by social media for expanding their perspectives. The learners were also coached by the facilitators and experts to solve the assigned problems

4.5 Creation and reflection. The innovation was created as the learning outcome. All participants in each group reflected how their innovation could solve the given problem.

5. The Constructivist learning environment for Education in 21st century efficiency assessment. The efficiency of the constructivist learning environment to enhance the pre-service teachers to integrate technology innovation in creative instructional design was inspected by three experts in educational technology and indicated that the content, media, instructional design, constructivist learning environments, and evaluation were appropriate. The teacher education must keep up with changes in technology innovations and how to apply them to enhance learning in the changing world.

6. The Constructivist learning environment for pre-service teachers' technology integration model was implemented in the experiment with 20 pre-service teacher students who were studying the course of 263-312 Technology integration in teacher education.

6.1 These students were divided into 4 groups of 5 for learning activities using the constructivist learning environment. The instructors evaluated the projects developed by these students based on the rubric.

6.2 The pre-service teachers' opinions indicated that the contents, media, and design were appropriate, and also support knowledge construction for learners.

6.3 The pre-service teachers also identified that, although it took more time in teaching and learning than the traditional instructional method, the students gained more experiences in searching for knowledge themselves and put into practices, studied in deep, and learn to collaborate and to reflect.

6.4 The pre-service teachers confirmed that this instructional model promote their creativity which could lead to the innovation in teaching and learning.

VI. Discussion and Recommendation

1. "Teaching about technology" and "Teaching with technology" are the significant points of views how to design the Educational Technology course for pre-service teachers. Some faculty members introduced or demonstrate technology innovations to their students, while some make use of those technology innovations to integrate in their teaching. This study intended to propose "Teaching with technology model" to integrate technology in teacher education program. They learned technology more meaningful and learned to integrated technology across curriculum.

2. The Constructivist new learning environment for pre-service teacher education to integrate technology is very essential to promote the new teachers to use technology in their professional practice, as they learn to design, develop, and integrate technology in real situation.

3. Multi learning resources can support the constructivist new learning environment and facilitate the new learning environment. They can be online and offline resources. The students expected more resources to support their learning.

4. The instructional scaffolding is very important for supporting students to perform the learning task efficiently and leading to success. The students made use of this tool to facilitate their learning.

5. The collaboration and coach of leaners in each group in learning process supported the problem solving and led to the creation of the project.

6. The creation and reflection of technology innovation in teaching and learning are crucial in professional practices, particularly in implementing the appropriate technology for schools. Guildford's types of creativity included the originality, fluency, flexibility, and elaboration [14]. Reflection is a crucial part of learning. The students will be trained to be the reflective practitioner [15].

From this study, the researchers proposed the school of education in 21st century as illustrated in Fig. 4.

Figure 4. Recommendation for 21st Century School of education

Three pillars of pedagogy innovation, technology innovation, and knowledge innovation were the supporting tools for the pre-service teacher education as well as the new literacy for 21st century – 3Rs – 8Cs. The new learning environment including the Student-center approach, the Knowledge-center, the Community-center, and the Assessment center were proposed as well as the new skills for students – Reflection, Inquiry, Technology use, and Knowledge construction. The strong foundations of Problem base, Learning resources, Scaffolding for instructional design and technology innovation. Finally, it is roofed with the constructivist learning environment in 21st century

ACKNOWLEDGMENT

This work was supported in part by Prince of Songkla University.

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Wasant Atisabda is Assistant Professor at the Department of Educational Technology, Faculty of Education and the Director of Research Center for Educational Innovations and Teaching and Learning Excellence, Prince of Songkla University, Thailand. He received B.Ed. in Teaching German as second language and M.Ed. in Audio-Visual Education from Chulalongkorn University, Thailand, After that, he graduated in Ed.Sp. in Educational Technology and Ph.D. in Higher and Continuing Education from University of Missouri, USA

Ophat Kaosaiyaporn is an Assistant Professor and also the Chair of Master's Program in Educational Technology and Communications at the Department of Educational Technology, Faculty of Education and also the Secretary and Committee Member of the Research Center for Educational Innovations and Teaching and Learning Excellence, Prince of Songkla University, Thailand. He received B.Ed. in Art Education and M.Ed. in Educational Technology and Communications from Prince of Songkla University, Thailand, and Ph.D. in Educational Communications and Technology from Chulalongkorn University, Thailand.

Nisreen Prompalad received B.F.A. degree from Silpakorn University and She got M.Ed. degree in Educational Technology and Communications from Prince of Songkla University, Thailand. Currently she is a researcher in Research Center of Educational Innovations and Teaching and Learning Excellence, Prince of Songkla University.