Ogata, H. et al. (Eds.) (2015). Proceedings of the 23rd International Conference on Computers in Education. China: Asia-Pacific Society for Computers in Education

Design and Development of Learning Environment to Enhance Creative Thinking and Innovation Skills for Teacher Training in the 21st Century

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Abstract: The purpose of this research was to design and develop the learning environment to enhance creative thinking and innovation skills of pre-service teachers in the 21st century. The developmental research (Type I): design and development process was employed in this study. Several methods used were document analysis, survey and case study. The following procedures were taken: (1) studying principles and theories, (2) synthesizing the designing framework, (3) designing and developing the learning environment based on above mentioned designing framework, and (4) evaluating the efficiency of the learning environment to enhance creative thinking and innovation skills. The result revealed that: 1) The learning environment comprises of: (1) Problem base, (2) Resources, (3) Related cases, (4) Mind tools, (5) Creative thinking and innovation lab, (6) Collaboration, (7) Scaffolding, and (8) Coaching. 2) The efficiency of this learning environment was evaluated by expert review. It was found that the learning environment is appropriate on 3 aspects: content, instructional design and media.

Keywords: Learning environment, Constructivist, Creative thinking and innovations

1. Introduction

Development of creative thinking of undergraduate students is one important target of many leading institutions in Thailand and worldwide in order to prepare students for their real working context or for continuing their education at the graduate level (The Office of the Higher Education Commission, 2011; Bonnstter, 2009; Holmes, 2009). Currently, there is a call for 21st Century Skills, and these skills include creativity skills. The teacher training instruction, especially in the course Basic Principles for Developing Educational Software, necessitates integration of creative thinking as the basis in the design (Master of Education Curriculum, 2009). Then it should be applied in the real situation where pre-service teachers will be able to design and development education software instruction appropriate to the course content, able to modify and build their own methods or adapt the method to create education software learning innovations which they could appropriately explain. This shows that the importance of the course correlates to the principle of creative thinking which is the major basis in the design of the instruction or the creation of education software learning innovations that responds to the course content and the needs of learners. Such instructional design corresponds to the major learning and innovation skills of the 21 Century, i.e., creativity and innovation, which will enhance intellectual skills in pre-service teachers of the 21st Century.

Enhancement of creative thinking in learners based on the web-based learning environment was achieved using the principles and theories for synthesizing the theoretical framework and the environmental design framework which promote creative thinking (Charuni Samat, 2009; Charuni Samat & Sumalee Chaijaroen, 2009). The theories and web-based characteristics were brought into the design of instruction that utilized the learning environment media and methods with important components of the Constructivist theory. The principle of creative thinking and web-based media

enabled us to design instructions that responded to learners' requirements at all places and time. It was possible to design learning missions that enhanced creative thinking with components of the learning environment, namely, resource, scaffolding, coaching, collaboration, participation and mental tools that supported problem solving for the learning mission. In this paper, we are presenting the principles related to the basis of creative thinking and innovation skills for producing teachers in the 21st Century and the basic context of teacher training in Thailand that would lead to development of innovations that enhance creative thinking for teacher training in the 21st Century of Thailand.

Thus, this research was aimed at designing and developing the learning environment from analysis of theoretical framework and learning environment design framework which enhanced creative thinking and innovation skills for pre-service teachers of the 21st Century in order to obtain the basis for constructing the appropriate and efficient learning environment models for the learners.

2. Methodology

This study was aimed to design and develop the learning environment to enhance creative thinking and innovation skills of pre-service teachers in the 21st century. Research methodology is developmental research Type I (Richey, RC and Klein JD, 2007) including; design and development process. The procedures were as following: 1) to examine the principles and theories. 2) to synthesize designing framework of the learning environment. 3) to design and develop the learning environment according to above mentioned designing framework, and 4) to evaluate the efficiency of the learning environment.

2.1 Target Groups

Target group in the design and development process consisted of (1) Experts –2 experts in content validity, 3 experts in instruction design who evaluated the learning environment, 3 experts in media to evaluate the quality of web-based media, and 2 experts in evaluation to evaluate the quality of research instruments. (2) Students – 34 of third year undergraduate students majoring in computer education, Faculty of Education, Khon Kaen University who registered for the course 237 311 Basic Principles for Developing Educational Software during the first semester of academic year 2014 comprised the target group.

2.2 Research Instruments

The instruments in this study as following details: 1) the expert review recording for examining the quality in various domains as follows: learning contents validity expert, instructional design experts and media experts, 2) the document examination and analysis recording form, and 3) The recording form for synthesis of the designing framework of the learning environment to enhance creative thinking and innovation skills. 5) The participant's characteristic survey for designers, developers, and students (Richey and Klein (2007).

2.3 Data Collecting and Analysis

The researchers collected the data as follows: 1) Synthesis of theoretical framework and Components of the learning environment. The data were collected by analyzing principles, theories, related research of the constructivism theory, cognitive theory, media and technology theory, pedagogy and contextual study. 2) Synthesis of Designing framework of the learning environment: The above synthesized theoretical framework was taken into this process. The underlined theories base such as, psychological base, pedagogies base, media and technologies base, contextual of Thailand teacher education base, and creativity and innovation skills for the teachers in the 21st Century base for the synthesis of the theoretical framework of the learning environment. 3) Design and develop of the learning environment based on foundation of creating designing framework was adopted. 4) Evaluate of the learning environment by experts, including 2 experts of the content, 3 experts of the instructional design, 3 experts of the media and 2 experts of evaluation and are revised according to suggestions. 5) Explore the characteristic of the participants including designers, developers, and students involved in the effective of the learning environment. The analytical description, summarization and interpretation were used to analyze data.

3. Research Results

The design and development of the learning environment that enhances creative thinking and innovation skills of pre-service teachers in the 21st century are follows:

3.1 The components of the learning environment model

3.1.1 Synthesis of theoretical framework

The result shows that the theoretical framework of the web-based learning environment consists of 5 theoretical base: **(1) Psychology base**, i.e., Constructivist theory; cognitive constructivist (Piaget, 1992) and social contructivist (Vygotsky, 1992) and Cognitivism Theory; schema and mental model theory, information processing theory (Klausmeier, 1985) and cognitive load theory, **(2) Pedagogical bases**, i.e., learning through collaboration and the principle of Constructivist learning environment design; OLEs model (Hanafin, 1999), CLEs (Jonassen, 1999) model and SOI model (Mayer ,1996), **(3) Media Theory and Technology base** including media symbol system and web-based learning, **(4) Thailand's teacher training context base** which includes policies, targets, present situation, processes, and performances, and **(5) Creative thinking and innovation skills base** for the teachers of the 21st Century including creative thinking theory (Guilford, 1967) consisted of 4 abilities of thinking as follows: Fluency, Flexibility, Originality and Elaboration and Creativity and Innovation Skills (Piirto, 2011) consisted of 3 process as follows: Think Creatively with Guilford's creative thinking theory, Work Creatively with Others: Develop, implement and communicate new ideas to others effectively; and Implement Innovations: Act on creative ideas to make a tangible and useful contribution to the field in which the innovation will occur. The theoretical framework are illustrated as below diagram.

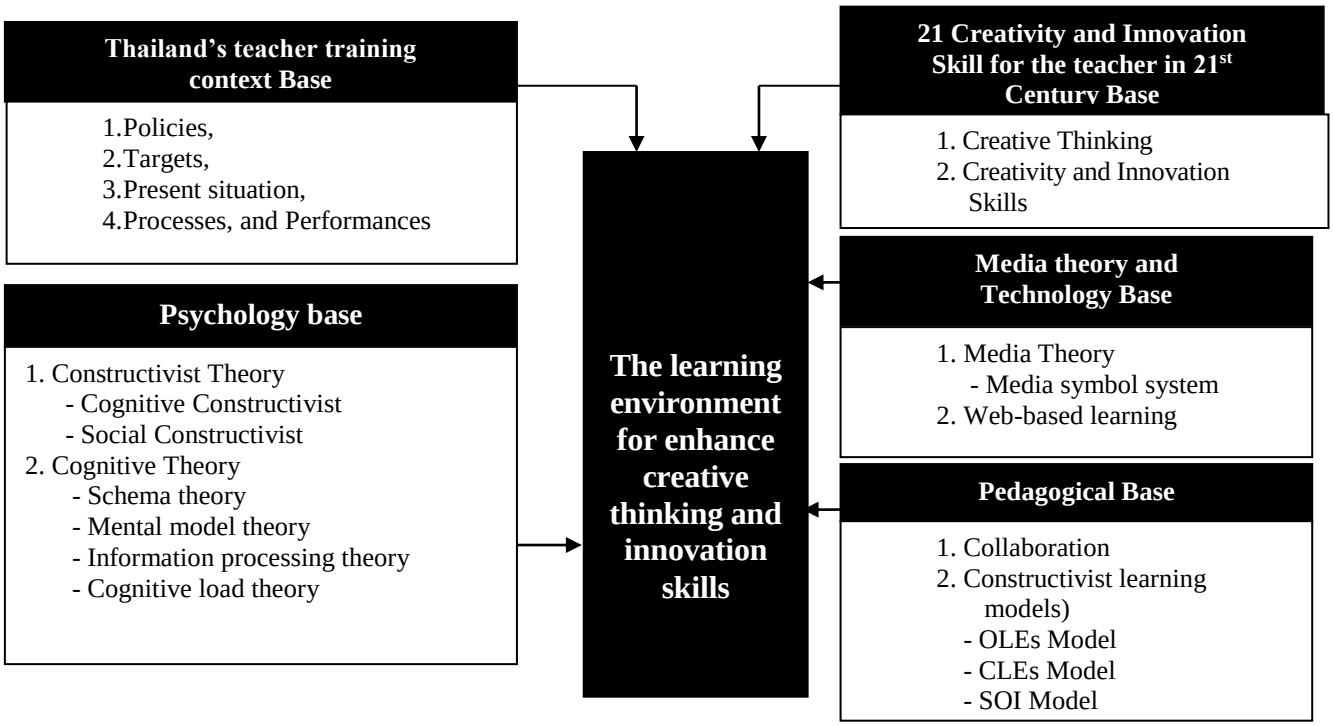
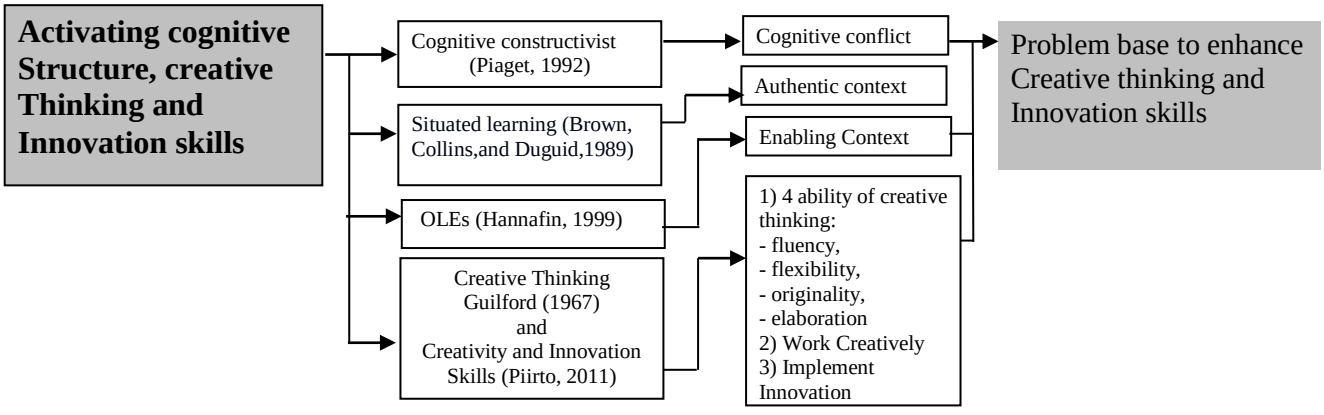


Figure 1. Theoretical framework of the learning environment for enhance creative thinking and innovation skills

3.1.2 Synthesis of Designing framework

According to this study, the findings of synthesis of the theoretical framework which was used as foundation in synthesizing the designing framework of the learning environments to for enhance creative thinking and innovation skills found that 4 crucial bases which include following details;

1) Activating cognitive structure, creative thinking and innovation skills: It is illustrated the relationship between the underlined theories and the component as follows: cognitive constructivism, situated learning (Brown, Collins, and Duguid,1989), OLEs (Hannafin, 1999) and Creative Thinking Guilford (1967) and Creativity and Innovation Skills (Piirto, 2011). Designing of the component of which is called *Problem base*. It focuses on authentic design and development of education software problem in daily life, Real world problem, contextualize problem. This help to activate cognitive structure of the students. **2) Supporting cognitive equilibrium**: It is illustrated the relationship between the underlined theories and the component as follows: cognitive theories, Information processing theory (Klausmeier, 1985), Mental model theory and SOI model (Mayer, 1996). Designing of the component of which is called *(1) Resources*. It focuses on how the students process the information effectively. This can help the students understand easily. *(2) The other component is Related case*. The underlined theories used is CLEs model (Jonassen, 1999). It focuses on providing multiple perspectives, themes, or interpretations on the problems or issues being examined by the learners. **3) Enhancing knowledge construction and creative thinking and innovation skills**: It is illustrated the relationship between the underlined theories and the component as follows: social constructivism (Vygotsky,1962). Designing of the component of which is called *(1) Collaboration*. It focuses on collaboration within a group of participants, shared decision making about how to manipulate the environment, alternative interpretations of topics and problems, articulation of learners' ideas, and reflection on the processes they used. *(2) The other component is Mind tools.* The underlined theories used is OLEs model (Hannafin, 1999; Iiyoshi and Hannafin, 1998; and Charuni Samat, 2009). It focuses on amassing of potentially important information which can be used to simplify subsequent access, support study in closer detail, or collect subsets of resources appropriate to individual learning needs. *(3) Creative thinking and innovation skills laboratory* which is derived from the creative thinking concept of Guilford (1967) and Piirto (2011). This laboratory enhances learners to think *fluently*: The learners showed creative thinking ability of Fluency that they can think of the answer quickly in limit time and variety of answers, *flexibly*: The learners showed creative thinking ability of Flexibility that they can find various kinds of answers freely and they can apply and adapt them to be useful for problem solving and increasing fluency to be new and different invented things, originally: The learners showed ability of creative thinking of Originality that they can think with new and different from general thinking by applying prior knowledge and adapting it as new things, and *elaboration*: The learners showed ability of creative thinking of Elaboration that they can widely and farther expand their thinking that they got used to practice such as their thinking in detail for decorating and expanding their main idea to obtain a more complete. It focuses on enhancing and developing of creative thinking and innovation skills. This can help the students to foster the ability of creative thinking and innovation skills. **4) Supporting and enhancement for constructing knowledge**: It is illustrated the relationship between the underlined theories and the component as follows respectively: constructivism, CLEs model (Jonassen, 2004), Social constructivist(Vygotsky,1962). It focuses on the Zone of proximal development to support the student as scaffolding and Coaching. *(1) Scaffolding* include Metacognitive Scaffolding, Strategic Scaffolding, Conceptual Scaffolding and Procedural Scaffolding. *(2) Coaching*, focus to monitor, analyze, and regulate the learners' development of important skills (Jonassen, 1999; Charuni Samat&Sumalee Chaijaroen, 2009). The relationship between the underlined theories and component are shown in Figure 2.



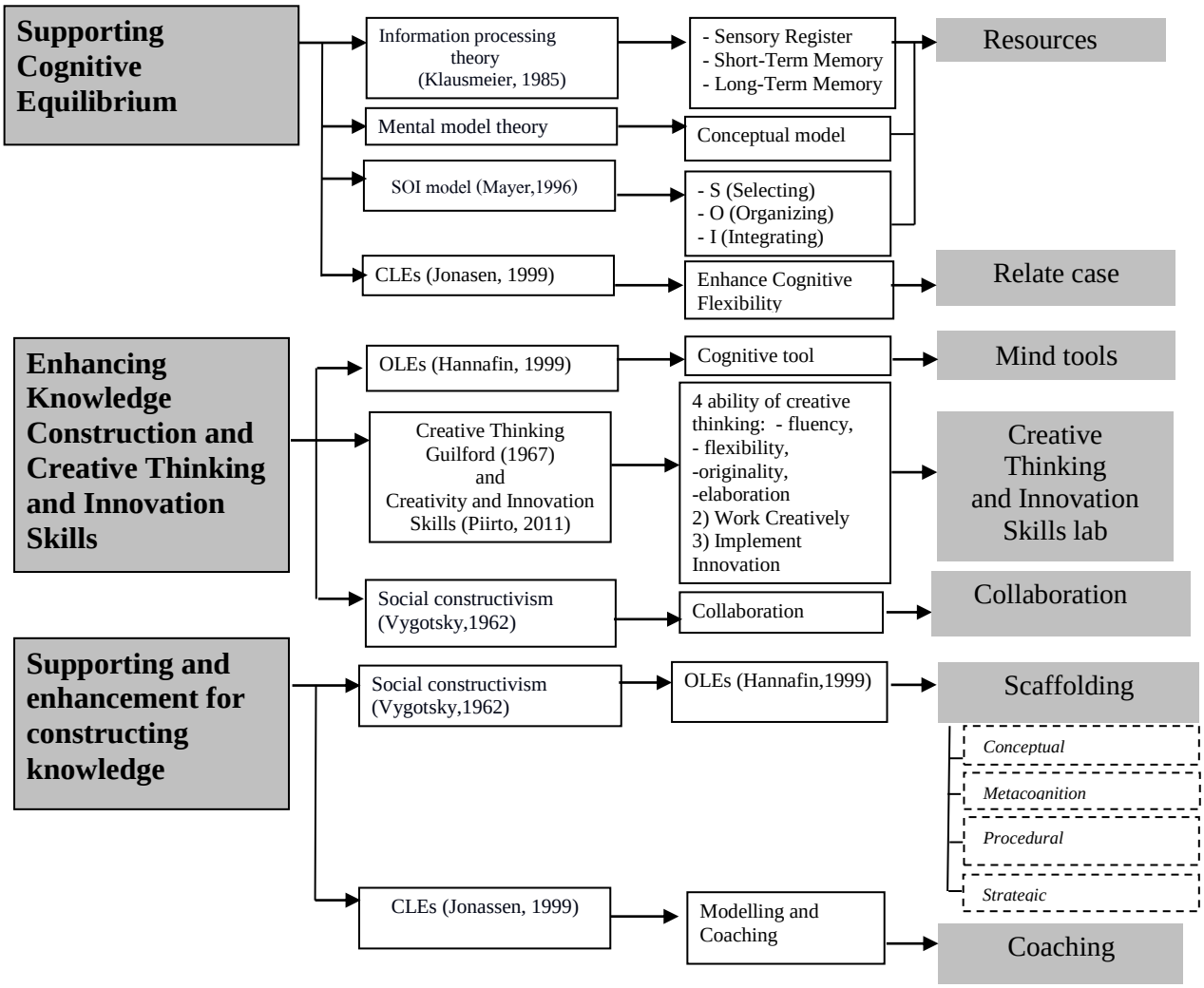


Figure 2. Designing framework of learning environment to enhance creative thinking and innovation skills

3.2 The efficiency of the learning environment model

The efficiency of the learning environment was evaluated using the framework for evaluating web-based learning efficiency of Sumalee Chaijaroen (2009; 2011), which has the following details: The Experts review which was found that the learning content, instructional design, media, and measurement and evaluation experts, are appropriate in all aspects as following details: (1) The expert review showed that the design of the learning innovations were appropriate and congruent with underlined theories and principles as mentioned above in the designing framework. Eight essential components were shown as follows: The content is accurate and appropriate to the level of learning among students. Contents are accuracy, interesting, up to date, clear. The language can communicate directly with the concept in learning and easy to understand. 2) Instructional design, the design of the learning environment are appropriate and congruent with underlined theories and principles as mentioned above in the designing framework. Some experts' suggestions were taken into consideration to improve the learning environment, such as the design of resources should increase the information processing of the learners by using cognitive strategies (advance organizer, concept mapping etc.) and media attributions. (2) The instructional design of learning environment exactly consistent with the principles and theories used as a basis for design overall, more appropriate, and providing creative thinking and innovation skills. (3) The media on a network that is designed

navigator helps people find information easily. Design, navigation structure similar to the easy access to information, not to confuse the students can access the network environment as a similar structure and stability.

4. Discussion and Conclusion

The study of the design and development of the learning environment confirmed the 8 important components i.e., (1) problem base, (2) resources, (3) related case, (4) mind tool, (5) collaboration, (6) creative thinking and innovation skills lab, (7) scaffolding, and (8) coaching. The findings correlated to the studies by Samat and Chaijaroen (2009, 2010); Chaijaroen (2012), Neo (2005); Terri (2005); Kwon (2006); Tezci (2008), who explained that development of techniques and approaches related to creative thinking could be applied in developing a tool for problem solving and learning mission and design based on the keywords as the basic information by setting a learning mission for learners to use their ability to find the answer adroitly, quickly, using multiple choices. Learners used their understanding as opposed to memory. This resulted in knowledge construction and enhancement of learners' creative thinking and correlated to the research work of Charuni Samat (2009) and Chaijaroen (2012) and who designed the learning environment model that enhances learners' creative thinking. We were able to conclude from the evidences in the interview protocol and the findings that learning from the learning environment model enhances creative thinking and learning achievement of the learners.

Acknowledgements

This work was supported by the Academic and Research Affairs, Innovation and Cognitive Technology Research Center, Faculty of Education, and the Research and Technology Transfers Affairs Division, Khon Kaen University.

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