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**The Development of Learning Innovation to Enhance Knowledge Construction and Critical Thinking for Undergraduate Student**

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**Abstract**

The purpose of this research was to develop learning innovation to enhance knowledge construction and critical thinking for undergraduate student. Research design was product and tool research. Several methods were used as document analysis and survey. The target groups of this study comprised 1) 5 experts to review the assessment of learning innovation's efficiency to enhance knowledge construction critical thinking for undergraduate student, and 2) 28 third-year students who studied in the course of design of on-line lessons. The procedures were as follows: 1) to examine and analyze the principles and theories, 2) to explore the context concerning knowledge construction and critical thinking of learners, and 3) to synthesize the theoretical framework and the designing framework of the learning innovation to enhance knowledge construction and critical thinking for undergraduate student. The findings shown that the learning innovation to enhance knowledge construction and critical thinking for higher education comprised 7 components as follows: 1) problem base, 2) learning resource, 3) scaffolding, 4) collaborative learning, 5) coaching, 6) Center for enhance critical thinking, and 7) related case

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*Keywords*— Knowledge Construction, Critical Thinking, Learning Innovation

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**Introduction**

Learning in the 21<sup>st</sup> Century in universities nowadays is affected by the high increasing of technology. Instruction tends to focus on the learning environment which is relevance to constructionism. Learning activities can occur anywhere. Primary learning objectives of a subject has changed to focus on setting a learning environment that increase students' performances. Among these changes, students are expected to construct their own value of understanding both inside and outside classrooms (Keefe, 2007).

In Thailand school environment observation from all over the country which consisted of 2,508 teachers about Thailand education in the views of teachers found that 30.36% of the teachers thought Thai students lack of critical thinking skill (Suan Dusit University, 2013). Moreover, students these days are raised in the digital environment, for example, communication technology, internet, laptop, and smart and portable devices, that makes their life more comfortable (Paitoon Srifa, 2012). Thus, learning instruction should facilitate hands-on activities through the usage of suitable technology (Smaldino, Lowther, & Russell, 2012).

In order to develop the learning innovation, the development should enhance students' knowledge construction process, support critical thinking not merely remembering. Importantly, the instruction must focus on situating cognitive experiences which make the learning more meaningful than only lecturing and remembering. Textbook facts may cause decontextualization of learning that students are not be able to apply knowledge into real life problems efficiently (Jonassen & Henning, 1999; White, 1993; Sumalee, 2014). This research aims to develop innovative learning to promote constructionism and critical thinking for undergraduate students preparing the students to face changes in the future, also to get the guideline to develop innovative learning and promote students' critical thinking skill. Then, the students will be able to adapt themselves through the shift of technology and learn life-long.

**Research purpose**

To develop the learning innovation to enhance knowledge construction and critical thinking for undergraduate student.

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## Research Method

The Developmental Research Type 1 was applied (modified from Richey's and Klein's, 2007) comprising 3 processes: 1) Design Process, 2) Development Process, and 3) Evaluation Process. Several methods were used as document analysis and survey.

## Target Group

- 1) 5 experts to review the assessment of learning innovation's efficiency to enhance knowledge construction and critical thinking for undergraduate student.
- 2) 28 third-year students who studied in the course of design of on-line lessons

## Research Scope

The scope of this research is to develop the learning innovation to enhance knowledge construction and critical thinking for undergraduate student. The theories used are as follows; 1) knowledge construction used as following 2 kinds: (1) Cognitive constructivism based on Jean Piaget (1965), and (2) Social Constructivism based on Lev Vygotsky (1925/1971) 2) The theory critical thinking bases on Ennis (2002) consisted of 5 process which are: 1) Elementary clarification 2) Basis for the decision 3) Basis for the inference 4) Advance clarification and 5) Supposition and integration.

## Research Instruments

The instruments used of in this study were 3 kinds as following details:

- 1) The document examination and analysis recording form. The scope of document analysis regarding with constructivist theories, critical thinking, and media theory.
- 2) The record form for synthesis of the designing framework of cognitive innovation to enhance knowledge construction and critical thinking for undergraduate student.
- 3) The expert review record form for evaluation of the Designing framework. The framework of this instrument consists of 3 major issues which are: 1) Content, 2) Multimedia, and 3) Design of the learning innovation to enhance knowledge construction and critical thinking for higher education

## Data Collection and Analysis

Data of the two processes were collected and analyzed as follows:

### 1. Design and Development Process

- 1.1 Literature review was performed to study and analyze the principles, theories, and related research in learning innovation to enhance knowledge construction and critical thinking for undergraduate student. The relevant theories studied included cognitive-related theories such as the information processing theory and Constructivist Theory. Multimedia symbol system was also included as the basis for our study, and the data was recorded in the document- checklist for analysis and interpretation.
- 1.2 Theoretical framework was synthesized from review of related theories and research from Number 1. There were 4 aspects synthesized: 1) psychological learning base, 2) pedagogical base, 3) content base, and 4) technological base.
- 1.3 Contextual study involved the course of design of on-line lessons. It comprised teacher's instruction. The data was collected by a survey of real context of instruction at third-year students who studied in the course of design of on-line lessons, teachers, and students, where knowledge construction and critical thinking were emphasized. The data was finally analyzed, concluded, and interpreted, together with the data obtained from in-depth interview.
- 1.4 The designing framework was based on the theoretical framework and contextual study.
- 1.5 The cognitive innovation was synthesized according to the designing framework in Number 1.4.
- 1.6 The designing framework and learning innovation components were examined, criticized, evaluated by experts; then improved and modified accordingly.

### 2. Evaluation Process

- 2.1 The learning innovation to enhance knowledge construction and critical thinking for undergraduate student was constructed from the synthesis of learning innovation components.
- 2.2 The learning innovation to enhance knowledge construction and critical thinking for undergraduate student were reviewed by experts in the aspects of: 1) content, 2) multimedia, and 3) the design that enhances knowledge construction and critical thinking for undergraduate student. It was then adjusted according to experts' suggestion before being analyzed and interpreted.

2.3 The learning innovation to enhance knowledge construction and critical thinking for undergraduate student was experimented on its efficiency in terms of the appropriate number of students per group, instruction process, and students' attitudes towards the innovation through observation, survey, and in-depth interview. The data was again analyzed and interpreted.

### Research Findings

#### 1. The design and development of learning innovation to enhance knowledge construction and critical thinking for undergraduate student.

Synthesis of the designing framework based on the theoretical framework prior to implementation in the design involved the following: 1) problem base, 2) learning resource, 3) scaffolding, 4) collaborative learning, 5) coaching, 6) Center for enhance critical thinking, and 7) related case, shown in Figure 1.



Figure 1 : The component of learning innovation to enhance knowledge construction and critical thinking for undergraduate student

#### *Problem base:*

Context enabling was conducted in accordance with Piaget's Constructivism which is based on cognitive development. It is believed that knowledge is derived from experiences, knowledge construction process, or action. An imbalance situation was designed where there was a cognitive conflict. With this basis, the researchers designed the problem base where authentic and real-world contexts were enabled, based on the Situated Learning principle so that learners could link new knowledge with their former experiences or knowledge (Jonassen, 1991).

*Learning resource:* is the source of data, content, information used by learners to solve the problems they confront. Learning resource contains various items learners can work out for the discovery. Design of Learning resource is based on the SOI Model which enables understanding and activation of cognitive processes that take place in learners' brain while they are learning and selecting related information (Mayer, 1996). The acronym SOI stands for 'select', 'organize', and 'integrate'. This is used with the theory of information processing. In designing the design bank, we presented information with a concept map showing relationships among all content, using graphic and moving pictures to present important content. For example, colors, sizes, underlining, and sounds were used to stimulate learners to select relevant information (S: select). Besides, Learning resource shows organization of information designed in the form of charts and maps for organization (O: organize) and presentation of pictures to let learners see the real world that might link to their former knowledge (I: integrate).

#### *Scaffolding:*

In order to support learners when they do their activities, scaffolding becomes very useful. Scaffolding presents or provides conceptual framework that assists learners in their work more than supporting learners in their capacity. According to Vygotsky's Social Constructivism related to the Zone of Proximal Development, learners who are above this zone can assist themselves while learners lower than this zone cannot. The latter can be assisted by scaffolding

(Vygotsky, 1971). The scaffolding consisted of 1) Conceptual scaffolding 2) Metacognitive scaffolding 3) Procedural scaffolding 4) Strategic scaffolding (Hannafin et al, 1999).

*Collaborative learning:*

This center promotes learners in doing collaborative activities. It is again based on Vygotsky's Social Constructivist, which states that, "Learners are able to construct knowledge through social interaction with others." Therefore, design of the Collaborative Learning emphasized missions where learners collaborated in problem solving. They exchanged knowledge and experiences among peers, or with teachers and experts to elaborate their concepts. Here, the Facebook social network was used for the activities.

*Coaching:*

Coaching was the component mainly to help the students to be able to do complex tasks with two models as observable process model and expert practicing model including cognitive process which is invisible. Coaching helped them to learn the correct procedures, its own reasons with the explanations based on cognitive apprenticeship of Collins et al (1991) was used as a principle to shift them from being novice to expert. So this component was designed in accordance with this principle by setting the teacher to analyze student's feedback, and guide them in learning process. The researchers design this coaching as in the classroom and online where they could raise a question to the expert all the time

*Center for enhance critical thinking:*

The research team designed the innovation to create the problem situation in authentic context, to practice their critical thinking skills, and to collaborate them on critical thinking. The critical thinking of Ennis (2002) was applied as process: 1) Elementary clarification 2) Basis for the decision 3) Basis for the inference 4) Advance clarification and 5) Supposition and integration.

*Related case:* based on constructivist learning environments (CLEs) (Jonassen, 1999). The important principle was to design to relate the experiences closed to problem which the students could refer and connect to their prior experience. The related case was design based on the theory of cognitive flexibility which designed and presented in various context in many complex levels embedded in information. So, in this case, the designing was well designed in cases related such as Fish Housing- the students could study this information and use to solve the problems about Life and its habitat relations. This would help them to think and solve other problems in the similar situation. This presented in terms of case samples, solution methods, and reasons.

*The evaluation of learning innovation's efficiency to enhance knowledge construction critical thinking for undergraduate student*

In this study, we found that the design and development of the learning innovation to enhance knowledge construction and critical thinking for higher education correlated to the principles and theories on which it was based. Constructivist's Theory enhances knowledge construction and information processing that supports memory register. Evaluative evidences were found in the following components:

*Content:*

The information content was clear, appropriate and holistic, thus facilitating learners' searching of knowledge. The language use was suitable for learners and easy to understand. The design of lexical-based statements and presentation of contents took multiple forms, for example, letters were highlighted with colors, moving pictures were used and the problem-based learning correlated to the content to study. Learners were encouraged to construct knowledge and on their own. The situations were planned to be similar to the true instructional problems. The researchers took into consideration experts' suggestions to improve the use of language so that it was more formal and organized appropriately for ease of study.

*Multimedia:*

This was found to be appropriate and interesting owing to still and moving animation with background sounds. Presentation of contents was efficient and the contents were organized in suitable categories so that students could click to select the content they wanted. The sizes were suitable, but the font colors should be improved for ease of reading. Statements were colourful, pictures and sounds were able to draw attention. Design was consistent with signposts that enabled conveyance of required information. Usage was simple. Links could be made for sentences or pictures, allowing efficient access to information. Design encouraged learners to act and utilize multimedia to the utmost extent. It supported collaborative learning and working in groups. Learners were encouraged to practice analyzing and practicing. Design of each mission encouraged all learners to participate in working and solving problems. It opened a chance for learners to learn independently and select what each wanted to learn by doing any mission first. Group work allowed collaborative learning where learners exchanged ideas. Learners were encouraged to enthusiastically learn on their own from real practice. Hence, they were able to construct knowledge and develop their thinking skills. The multimedia enabled learners to learn at anytime and anywhere they wanted.

*Design of the learning innovation to enhance knowledge construction and critical thinking for higher education:*

It was found that the innovation supported learning and group work. Everyone participated in working and decision making for problem solution. Learners learned independently and selected an item to study according to their interest. The learning atmosphere was suitable. Collaborative learning allowed exchanges of ideas. Learners could learn anytime and anywhere. There were tools for learners that assisted them to understand what they learned profoundly. Scaffolding and coaching supported learners to think and solve their problem. And regards the expert's assessment, the consistency between the theory and theoretical and designing framework was found.

## Conclusion and Discussion

In the design and development of the learning innovation to enhance knowledge construction and critical thinking for undergraduate student comprised 7 components as follows: 1) problem base, 2) learning resource, 3) scaffolding, 4) collaborative learning, 5) coaching, 6) Center for enhance critical thinking, and 7) related case. The reason why such elements were included in the innovation may be because the design and development of 'constructivist learning innovation to enhance critical thinking for higher education was based on ID theory. The ID theory was originally taken from constructivist theory which focuses on the knowledge construction and critical thinking based on Ennis (2002). This study applied theories and critical thinking which emphasized all of 5 process: 1) Elementary clarification 2) Basis for the decision 3) Basis for the inference 4) Advance clarification and 5) Supposition and integration. as the bases for the instructional design. Our findings correlated to studies by Hongsunee Uarattanaksa et al, (2012) and Petchtone, Puangtong and Chaijaroen, Sumalee (2012) Relevant theories, including the Constructivism, Cognitivism, principles and other theories on learners traits needed to be developed were incorporated in the design together with multimedia. The multimedia characteristics and the symbol system that enhances knowledge construction and critical thinking were taken into consideration. The said studies were different from our research which emphasized the design of innovation that enhances knowledge construction and critical thinking for higher education using the Theoretical Framework consisting of 1) psychological learning base, 2) pedagogical base, 3) content base, and 4) technological base. It was also found that the learning innovation examined by experts in terms of quality and the evaluation of usage should have 3 members per group for effective collaborative learning.

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## References

- Collins, A., Brown, J. S., & Holum, A. (1991). Cognitive apprenticeship: Making thinking visible. *American educator*, 15(3), 6-11.
- Ennis, R.H. (2002). *Super-streamlined conception of critical thinking* (1). Retrieved from <http://tonydude.net/NaturalScience1000/Topics/1Universe/zzcriticalthinking.html>.
- Hannafin, M.J., Land, S., & Oliver, K. (1999). Open learning environments: Foundations and models. In C. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory* (pp. 115–140). Mahwah, NJ: Erlbaum
- Uarattanaksa, H., Chaijareon, S., & Kanjug, I. (2012). Designing framework of the learning environments enhancing the learners' critical thinking and responsibility model in Thailand. *Procedia-Social and Behavioral Sciences*, 46, 3375-3379
- Jonassen, D.H. (1991). Towards a constructivist design model. *Educational Technology*, 34(4), 34-37.
- Keefe, J. W. (2007). What Is Personalization?. *The Phi Delta Kappa*, 89(3), 217-223.
- Mayer, R. E. (1996). Learning strategies for making sense out of expository text: the SOI model for guiding three cognitive processes in knowledge construction. *Educational Psychology Review*, 8(4) 357–371.
- Paitoon Srifa. (2012). Preparing to adjust into 21<sup>st</sup> century classroom to deal with laptop. *CAT Magazine*, 9(30), 42-43.
- Petchtone, P., & Chaijaroen, S. (2012). The development of web-based learning environments model to enhance cognitive skills and critical thinking for undergraduate students. *Procedia-Social and Behavioral Sciences*, 46, 5900-5904.
- Piaget, J. (1965). *Judgment and reasoning in the child*. Translated by Marjorie Warden. London: Routledge & Kegan Paul.
- Richey, R. C. , & Klein, J. (2007). *Design and developmental research*. New Jersey, NJ: Lawrence. Rinehart and Winstin, Inc.
- Smaldino, S. E., Lowther, D. L. & Russell, J.W. (2012). *Instructional technology and media for learning*, (10th Ed). Boston: MA: Pearson Education.
- Suan Dusit University. (2013). *Thailand education in teachers' views*.
- Vygotsky, L. S. (1972). *The Psychology of art*. Cambridge, MA: MIT Press.