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A DEVELOPMENT OF CONSTRUCTIVISM LEARNING OBJECT TO ENHANCE KNOWLEDGE CONSTRUCTION AND CRITICAL THINKING OF UNDERGRADUATE STUDENTS

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Abstract

This research and development aimed to study, develop, and implement the constructivism learning object to enhance knowledge and critical thinking of undergraduate students. The independent variable was the constructivism learning object and dependent variables were knowledge construction and critical thinking skill of the undergraduate students. The sample was 163 third year medical students of Suranaree University of Technology, derived from simple random sampling using Taro Yamane formula. This research contained 4 phrases: 1) studied and analyzed basic knowledge and surveyed the opinion of 19 experts by DELPHI technique, 2) developed the constructivism learning object, 3) implemented the constructivism learning object.

The research instruments were learning object media, survey form of opinion to learning object, knowledge construction test, critical thinking test, interview recording form. The data was statistically analyzed by percentage, mode, I.R., mean, standard deviation, inter-quartile range, and t-test of dependent group.

The research findings were as follow:

1   All of the experts agreed coincidently with the constructivism learning object (Median = 5, I.R. = 0.67) and agreed with the constructivism learning object in all components at the level of "most" (mean = 4.83). The constructivism learning object was composed of 6 steps; 1) state the problem, 2) study the problem, 3) solve the problem, 4) construct knowledge, 5) implementation, 6) evaluation.

2   The critical thinking skill of the students after studying with constructivism learning object was significantly higher than before studying at the level of .05.

3   The level of elaboration was high at 28.57%.

Keywords: Learning object, knowledge construction, critical thinking.

1   INTRODUCTION

A development of information technology for education is the country policy to get ready for being information technology society and knowledge society. Every country focuses on developing the strategy of intellectual human resources and has critical thinking, and has lifelong learning and gain the information technology skill for developing the educational technology policy. There is a framework of developing strategy on content development that to change the model from the prior model. The content of leaning objects should be changed from the old way by using information technology as a tool to take learners to the knowledge asset and varieties of learning resources. The content must urge the learners to learn, and to think critically, creatively, and being good citizen in varieties of culture in social.

The study of science learning process in undergraduate level from 8 universities in Thailand [7] found that the electronics media was inadequate for learners to develop the critical thinking process and self – study skill. So the way of solving problem is to develop new instruction model called learning objects. Learning object is the small digital learning unit in form of document, sound, pictures, graphic, message, animation including electronic lesson used in information presentation. The learning object consisted of learning objectives, content, interactive drill, and learning achievement test. Learning Object is small and takes short time to learn, and reusability, sharable, and interoperability.

This research of developing constructivism learning object using the constructivism theory as a principle to design in open learning environment: OLEs which open opportunity for learning by multiple prospection, collaborative, and information searching from many resources and help to manage the

learning environment with learning objects. The open learning environment composed of 4 components; 1) accessing to the context, 2) learning resources, 3) tools, 4) scaffolding, and gain the teaching method called "PSPSKAPE" which consists of 6 parts 1) Present the Problems 2) Study the Problems 3) Finding for Problem Solutions 4) Knowledge Creation 5) Applications, and 6) Evaluation. [3] In addition, the science instructional model in any level of study is not only developing the learners achievement, but also develop the advanced critical thinking skill. Higher-ordered thinking is one of intellectual ability to develop for learning content, principle and ideal of other subjects.

A development of constructivism learning object in this research aimed to solve problem of science instruction management in undergraduate level to develop the critical thinking process, inquiring, enhancing knowledge individually via constructivism learning object and guide to develop new effective science teaching model.

2   RESEARCH OBJECTIVES

1   To study the constructivism learning object model to enhance knowledge and critical thinking of undergraduate students.

2   To develop the constructivism learning object model to enhance knowledge and critical thinking of undergraduate students.

3   To study the result of using constructivism learning object model to enhance knowledge and critical thinking of undergraduate students.

3   VARIABLES

Independent variable: constructivism learning object model.

Dependent variables: knowledge construction, critical thinking skill.

4   RESEARCH LIMITATION

1   The population was undergraduate students, faculty of medicine, Suranaree University of Technology. The samples were 163 undergraduate students, faculty of medicine, Suranaree University of Technology, derived from simple random sampling using Taro Yamane table.

2   The content of this study concerned about Antimicrobials, Cancer chemotherapy, Blood disease medicine, Inflammation and gouty medicine in courses of Medical Pharmacology II (the undergraduate students of science, 6 weeks course attention, 4 hours a week, total was 24 hours.

3   The learning management was online learning with learning management system: LMS.

5   OPERATIONAL DEFINITION

Constructivism learning object means a small and completed unit of instruction that composed of objectives, content, responsive drill, test for learning evaluation of self-contained. In a learning object contains the process of 6 learning steps; 1) Present the Problems, 2) Study the Problems, 3) Finding for Problem Solutions, 4) Knowledge Creation, 5) Applications, and 6) Evaluation. Learning object provides learning environment as the principle of open learning environment (OLEs) consisted of enabling context, resource, tool, scaffolding, reusability, interoperability, retention, and accessibility.

Knowledge construction means the ability to construct knowledge of the learners. The knowledge construction is occurred in the process of learning in the learners to study individually by learning object. The prior knowledge and new knowledge are related and analyzed, synthesized, summarized to reflex the learners to gain new knowledge. The knowledge construction can be evaluated using Van der Meijdem's coding scheme [9], [11] Critical thinking skill means the ability of critical thinking, synthesis thinking, problem perceive, using reason, considering, cause and reason connection to summarize for the answer reasonably. Critical thinking skill can be evaluated by Cornell Critical Thinking test, Level Z. [2]

6   RESEARCH METHODOLOGY

This research and development had 4 research phrases methodology as follow:

- Phrase 1 Study, analyze, and synthesize the basic information about designing learning objects using constructivism learning theory.
- Phrase 2 Develop the draft of constructivism learning objects.
- Phrase 3 Study the result of using constructivism learning objects.
- Phrase 4 Present the model of constructivism learning objects.

7   RESEARCH FINDINGS

The researcher studied, analyze, and synthesize the basic information about designing learning objects using constructivism learning theory from the text, documents, related research, online materials from internet about the characteristics of learning objects, process of knowledge construction, open learning environment (OLEs), critical thinking, and the instructional process. After that the researcher summarized the model of constructivism learning objects composed of 4 components: characteristics of learning objects, knowledge construction process, open learning environment, and critical thinking. The description was as follow:

7.1   The characteristics of learning objects consisted of 6 components:

1   Overview – this component included the overview of learning process such as instruction advice, manual for instruction management, learning objectives, contents of the learning objects, conceptual framework to express the overview of instruction process.

2   Content – this component collected all information related to the content of learning objects such as texts, pictures, animation, sound, video. The content is focused on individually self-controlled of learners.

3   Practice – this component composed of 6 steps of learning process; Present the Problems (the learners connect prior knowledge and new knowledge by asking questions, identified the problem, using real situation or simulation for stimuli to think), Study the Problems (learners studied and make understanding with the questions, problem or situation encountered by surveying, finding, discussion), Finding for Problem Solutions (finding the answer by group working to search for the answer, solve the problem or eliminate the problem according to the real situation or identified simulation of problem), Knowledge Creation (create the explanation, present the method of solving problem, knowledge sharing, summarize the new knowledge among group of learners, and evaluate the new knowledge), Applications (bring the new knowledge to apply in any situation), and Evaluation (self - evaluated the learning process and product, by friends, and instructor, and plan to improve continually to gain knowledge and develop critical thinking skill and knowledge construction.

4   Resource – this was electronic learning resource to use for learning. Resource included the static resource such as principle, theory or rules, dynamic resource that always change. Resource also referred to personal learning resource, experts who could suggest the learners about learning. Beside, resource could be the open learning environments (OLEs) that supported the learner's knowledge seeking.

5   Summary – this component expressed new knowledge by recording knowledge constructed on discussion board.

6   Assessment – the assessment both pretest and posttest in terms of both critical thinking skill and learning achievement. After pretest, the learners studied content from media and participated in learning activities via the problem situation, questioning and solve to construct knowledge, expressed idea or knowledge on discussion board. And then did the posttest including critical thinking skill and learning achievement. The knowledge construction was inspected from knowledge expressed on discussion board.

7.2   Knowledge construction composed of 5 steps:

1   Survey the prior knowledge and experience of the learners.

2   Stimuli the learners to gain cognitive conflict by asking questions or problem situation.

3   The learners perceive information for assimilation. When the existence of disequilibrium occurs, the learners try to adapt to gain equilibrium by finding the answer.

4   To find the answer of conflict, the accommodation will be occurred to the learners and then the learners will be able to describe and solve the problem.

5   When the learners get into the equilibrium, the learners will learn.

7.3   Open Learning Environments has 4 components:

1   Enabling context - the teacher can specify the problem for the students or the students can specify the problem by themselves.

2   Resource - the resources will support the information for learners in terms of static resource and dynamic resource.

3   Tools - the tools includes processing tool that support the learning process of cognitive domain related to open learning such as seeking tool, collection tool, organization tool, integrating tool, generation tool, manipulation tool, tool for surveying, and give a chance for the students to operate graphic work, for example, to show the structure of inside human body. The learners can manage with the pictures by enlarging or turning by themselves. The communication tool supports the learners to try for creative thinking or share the knowledge with teacher, friends, and experts. Communication tool is synchronous tool such as 'Chat' that supports the learners to talk, share, and solve problem, and the asynchronous communication tool, for example, 'discussion', 'Email', 'Homework'

4   Scaffolding- the helping process has 4 types; Conceptual scaffolding – this helps to create concept for learners to encounter the context of problem. Scaffolding focuses on the relationship between concept and problem by using a graphic of concept map to connect the important concept and the content. This helps the learners to create concept and understand the content and finally solve the problem. Metacognitive scaffolding suggests the way of thinking during the learning process using message to urge the learners to think and solve problem. Procedural scaffolding is to suggest the way of using learning resources and tools in learning environment by describing the components of the tool under the learning environment. The learners will check and select to use and solve the problem. Strategic Scaffolding helps for supporting critical thinking, planning, using message or diagram about solving problem. Strategic Scaffolding is to introduce and guide for solving problem to advance thinking

7.4   The 4 steps of critical thinking

1   Questioning assumptions is to identify the hypothesis of the learners, criticize, and inspect oneself hypothesis or others.

2   Detecting bias is to check correctness and bias of the information and resources.

3   Analyzing context is to analyze the environment and other functions influenced to the idea, operation, and translation the data for appropriate questioning.

4   Seeking alternative points of view and sources of information is to describe or guess the answer and express the idea, discussion for considering related data, accept or decline the information, and finally to construct new knowledge or new idea.

Development of Constructivism Learning Objects Model - the result of phrase 1 by analyzing and synthesizing information and design the prototype of model and study the opinion of 19 experts using computer-based Delphi. The 19 experts were specialized on instructional design, web-based instruction, computer assisted instruction, science teaching, critical thinking. The issues for studying opinion were 1) learning objects components, 2) description of related components, 3) steps of learning activity, 4) description of learning activity, 5) opinion and suggestion. After gaining the Constructivism Learning Objects Model, the model was evaluated the item objective congruence: IOC for validity by considering the questions by item, and the harmonization of theory and components, and steps of learning objects. Then, improve the model as the suggestion of the experts. The evaluation found that the experts had mostly opinion at the level of "most" (Mdn. = 5, I.R = 0.67) and mean was at the level of "most" (mean = 4.83)

The evaluation of quality of constructivism learning objects developed by the principle of Kay and Knaack (2008) found that the constructivism learning objects had 5 components and 17 items. The study found that the quality of constructivism learning objects on 5 components; Interactivity, Design, Engagement, Usability, and Content. The overview of constructivism learning objects gained the quality at the level of "most" ($\bar{x}$ = 4.87 S.D. = 0.33) and considering on quality, the content gained the quality at the level of "most" ($\bar{x}$ = 5.00 S.D. = 0.00), the engagement gained the quality at the level of "most" ($\bar{x}$ = 4.92 S.D. = 0.27), the quality of interaction was at the level of "most" ($\bar{x}$ = 4.80 S.D. = 0.41), the usability gained the quality at the level of "most" ($\bar{x}$ = 4.87 S.D. = 0.35), design gained the quality at the level of "most" ($\bar{x}$ = 4.80 S.D. = 0.41).
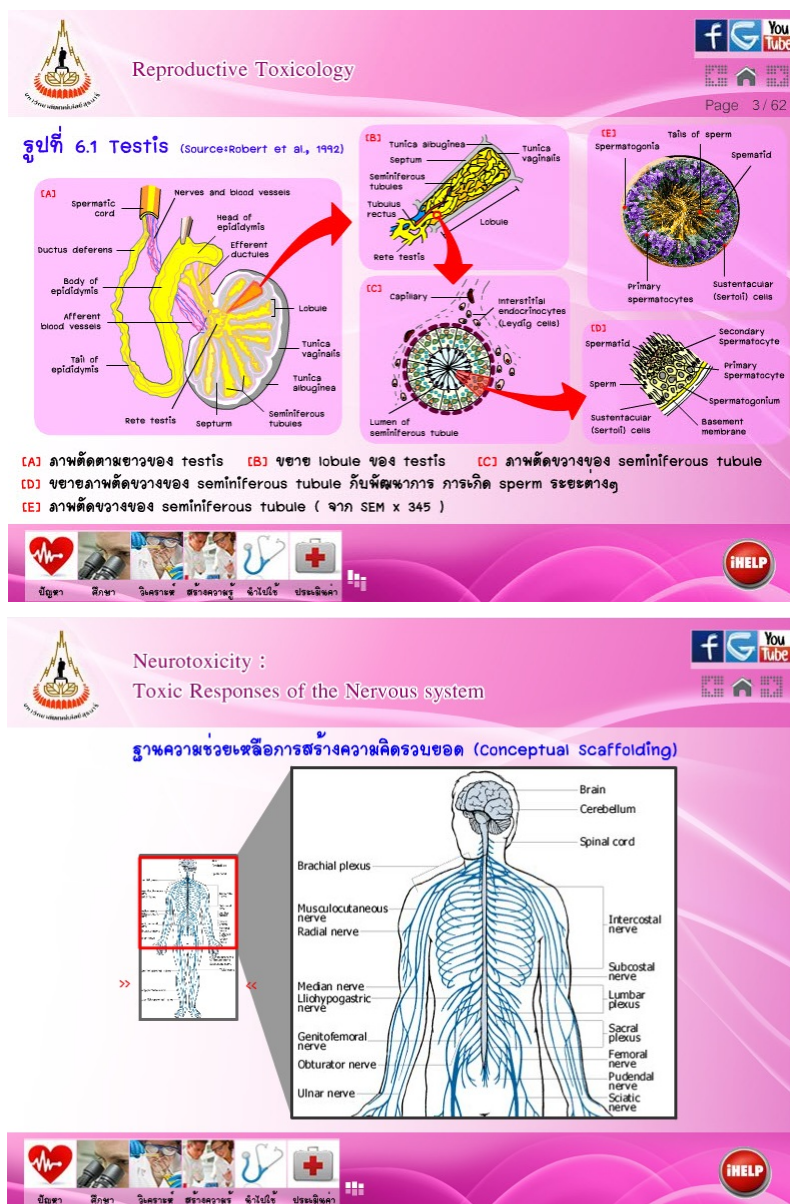

Fig. 1 the constructivism learning objects.

The use of Constructivism Learning Objects

The researcher took constructivism learning objects to try out with the samples who were 163 undergraduate third year students, faculty of Medicine, Suranaree University of Technology. The try out lasted 6 weeks, and the research findings were that

The analysis for supporting knowledge construction of samples that used Van der Meijdem's coding scheme as a tool. The analysis for knowledge construction consisted of 6 components: 1) Cognitive:

Asking Questions, 2) Cognitive: Asking Answers, 3) Cognitive: Give Information, 4) Affective, 5) Regulative, 6) Rest. The samples had the level of knowledge construction of high-level elaboration at 28.57%, the level of knowledge construction of low-level elaboration at 49.86%, the level of knowledge construction of affective contributions at 15.09%, the level of knowledge construction of regulative contributions at 6.48%. Considering in any item, the learning process of cognitive: Asking Questions of the samples – the question that need the answer (CHV2) was at 4.31%, the confirmation or asking agreement (CHVER) was at 9.16%, the perception process of giving answer found that the samples answered without explanation (CHG1) was at 2.96%, and the learners answered and explained the problem solving (CHG2) was at 12.40%, the perception process of giving information technology (Cognitive: Giving Information) found the samples specify the new knowledge but not extend the knowledge (C11) was at 1.62% and the samples specify the new knowledge with knowledge extension (C12) was at 9.97%, the notice reference or prior information (CIT) was at 9.70% and the samples evaluated, summarized or give opinion (CIE) was at 13.48%

In addition, the acceptance of supporting from others without opinion (ACCEPT-) was at 12.95%, the samples accept the support of others by giving more opinion (ACCEPT+) was at 1.90%

On the affective, found that the positive emotion or negative emotion that reacted to the cooperation or pay attention to the task (A) was at 15.09%, the control, regulation found the planning, following, and task evaluation or group was at 1.61%, and there was suggestion of teacher to the samples was at 4.85%

The result of critical thinking skill of the samples. The result found that the mean score of critical thinking after the treatment was at 43.55, S.D. = 3.57, and significantly higher than the critical thinking mean score before the treatment was at 23.14 S.D. = 7.12, at the level of .05. Considering on item, the critical thinking of the samples on 6 components; deductive summary, definition, reliability consideration, observation, inductive summary, summary by hypothesis testing and forecasting, definition and identifying the assumption. The critical thinking skill after treatment was significantly higher than before treatment at the level of .05.

8   DISCUSSION

1   The constructivism learning objects enhancing critical thinking skill found that the characteristics of learning objects and symbols of media was able to response knowledge construction as the theory of constructivism. The learning environment which adds up the principle of knowledge construction with media that connected to hyperlink, hypertext, or hypermedia. The learners had to study the theory of toxic that affected to physical system of human, toxic to the human organ, diagnostic, evaluation on injury, treatment and toxic prevention to the human body, ill-structured. So the learners must analyze the injury of the organ and connect to the knowledge for diagnostic the injury, and solve the problem of injury. So the knowledge of one situation of problem to the new situation called "Learning transferring" [10] was very important in the rapid change society of information. Learning transferring is important. The learners don't know the condition of problem will enhance the learners to think critically, then construct knowledge and solve the problem using new knowledge.

2   The result of constructivism learning objects enhancing critical thinking skill found that the use of constructivism learning objects was able to enhance knowledge construction. The samples gained high-level elaboration at 28.57%, and low-level elaboration at 49.86%. This was harmonized to the research of [1]*,* [9] that found the knowledge expression on asynchronous discussion board of the samples, the knowledge construction was at the level of "low" more than the level of "high". The discussion board was used as tool for teachers to evaluate the process of thinking. The analysis of knowledge traced back by the correct response. The teacher took action to introduce for the learners. The different discussion of the learners can urge the learners to gain knowledge construction. The questioning also helps the learners to attend and search more information individually.[12] The media design should support the learning activity to construct knowledge in advance level. [8] mentioned that the learners can be able to describe the knowledge or experience got form the learning activity with motivation and responsibility and lead to gain more efficiency of learning.

From the research finding, the samples gained more critical thinking skill after studying via of constructivism learning objects enhancing critical thinking skill in 6 weeks. There was 6 components of constructivism learning objects; deductive summary, definition, reliability consideration, observation, inductive summary, summary by hypothesis testing and forecasting, definition and identifying the

assumption. The critical thinking skill after studying via constructivism learning objects was significantly higher than before studying at the level of .05. This research was harmonized to the research of [4] that studied science learning management using cycle of inquiry learning enhancing critical thinking and satisfaction of Mathayom Suksa 1 Students for 6 weeks the critical thinking skill of the students was significantly higher at the level of .01.

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