Design and Development of Web-Based Learning Environment to Enhance Learner's Analytical Thinking

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Abstract: The purpose of this research was to design and develop learning environment to enhance learners' analytical thinking. The target group were **1** experts who evaluated the content, 2 experts who evaluated conceptual framework of the web-based learning and its design, 2 experts who evaluated the cognitive innovation, and 1 expert for the assessment and evaluation. Document analysis and survey research was employed via the procedures as 1) studied the theory and principle, 2) studied the relevant context, 3) synthesized designing framework of web-based learning environment by analytical thinking framework, 4) designed and developed web-based learning environment, and 5) evaluated the effectiveness of the learning environment. The qualitative was collected from opinion surveying form, interviewing, and analyzed by interpreting and in descriptive analysis. The results were revealed that: the web-based learning comprised **6** components as the following: 1) Problem Base, 2) Resource, 3) Collaborative, 4) Analytical Thinking Center, 5) Scaffolding, and 6) Coaching. And the assessment on content was found that suitable for learning, on web-based learning was found that such 6 components were designed in consistent with the studied theory and principle, on designing of the web-based learning was found that was appropriated for enhancing learner's analytical thinking.

Keywords: Web-based learning environment, constructivist, analytical thinking

1. Introduction

Recently, information technology and communication has developed rapidly and has taken an essential role in daily living. The information technology era influences a number of Thailand's variation that affects human's learning in the 21th century. Due to a variety of information available, it has promoted a transformation of the society into the society of learning. Therefore, seeking knowledge in the society, where a wealth and variety of information exists, requires analytical thinking skills in order to enable the ability to differentiate the useful and useless information. Thus, analytical thinking in learning is in need of promotion.

According to the changing state, classroom instruction must be adjusted from the teacher-centered paradigm to student-centered. This paradigm encourages the learners' capacity and eagerness for self-learning. The essential approach to develop the learners' reaction towards information which comes along with social changes is based on a constructivist theory. The theory supports self-learning and the reaction towards the change of the learning paradigm through a cognitive process which encourages learners to learn through their actions based on their cognitive process. The old knowledge will connect with the new one that extends the cognitive structure (Chaijaroen, 2008). Especially, science is related to cognitive learning because this subject requires the ability on analysis and classification of the logical relationship. Therefore, it requires learners to be able to integrate and apply the gained knowledge to their daily life.

The previous study demonstrated that when applying the basic principle of a learning theory, namely a constructivist based on Piaget's concept, it stimulates learners' learning by the problem that led to a cognitive conflict or cognitive imbalance. They are required to improve the balance of their cognitive structure. The cognitive becomes balanced by extending the schema of experience through assimilation and accommodation. This kind of cognitive process focuses on self-learning and their actions combined with media networks including the media attribution and the media symbol system. The knowledge will be transferred through animation, slides, visual media, charts, videos, and

hypertext from the network of a media symbol system. In addition, the hypertext acts as a hyperlink including node, main and sub, as well as the connection between each node. The hyperlink can build up the foundation and extend learners' knowledge effectively. Consequently, using a media symbol system to transfer knowledge affects learners' comprehension and their cognitive process, which in turn has an effect on their learning (Chaijaroen, 2008). Moreover, the learning environment with the combination of relevant principles, theories and media attribution is organized to encourage learners to create new knowledge. In so doing, they are able to study, think, research, conduct an experiment, and brainstorm from media or any other sources for learning. From this kind of learning, the old knowledge and the new knowledge will be associated under teachers' supports. For this reason, network-based learning environment is a foundation of knowledge that will be an effective tool to support the knowledge construction of learner as well as to extend learners' thoughts. Consequently, the learning environment is suitable for self-learning and supports their cognitive process and analytical thinking.

As discussed above, this study noticed the importance of designing and developing network-based learning environment on the basis of the constructivist theory, which promotes analytical thinking. The study was based on the principle and theory from previous research related to knowledge construction and analytical thinking. The reviewed principle and theory were designed and developed for network-based learning environment intended to promote learners' knowledge construction and analytical thinking. Then, the knowledge was synthesized into the elements of network-based learning environment; subsequently, designation and development of the environment were provided. The findings would develop the quality of learners' capacity, analytical thinking and self-development. They would develop the character of learners which should be in sync with basic education curriculum; specifically, they are able to apply the knowledge to daily life reasonably.

2. Research Purpose

To design and develop learning environment to enhance learners' analytical thinking.

3. Conceptual Framework

The design and develop of learning environment to enhance learners' analytical thinking consisted of 1) designing principles of web-based learning environment, 2) constructivist theory, 3) cognitivisim theory, 4) analytical thinking. Then, these were synthesized to be a theoretical framework of the web-based learning environment.

4. Research Methodology

The Developmental Research.

4.1 Target Group

The target groups were divided into 2 groups regards to these 2 processes as follows:
1) Design process: 2 experts to assess the designing framework in learning environment to enhance learners' analytical thinking of student.
2) Development process: 3 experts to assess the efficiency of the learning environment to enhance learners' analytical thinking of student for the aspects of content, media, and design.

4.2 Data Collection and Analysis

The data was collected and analyzed in each process as follows:

4.2.1 Designing Process

1) Literature review: studied and analyzed theories, principles, and related researches concerning the design of learning environment to enhance learners' analytical thinking of students in terms of a) constructivist b) cognitivisim including media attributes, media symbol system, multimedia as a study background, and then recorded in a document recording form. The data was analyzed by the methods of interpreting and analytical description.

2) Theoretical framework: reviewed, studied, analyzed the mentioned theories and researches in Literature Review process, and then recorded in the conceptual framework recording form. The data was analyzed by the methods of interpreting and analytical description. The framework consisted of 6 backgrounds as a) psychological learning base, b) pedagogy base, c) context base d) media theory base, e) technology base, and f) analytical thinking base.

3) Designing framework: synthesized the designing framework based on theoretical framework. The design focuses on the process of knowledge construction based on constructivist, analytical thinking, and transformed principles into practice by designing the elements of web-based learning environment. The data was analyzed by the methods of interpreting and analytical description. Its Quality was assessed by research adviser, experts to have suggestions for improvement.

4) Proposed the designing framework and learning environment components to the experts to verify the consistency between theory and designing framework of learning environment components by criticized and assessed in order to improve learning environment. The data was analyzed of interpreting and analytical description

4.2.2 Development processes

1) Developed learning environment to enhance learners' analytical thinking based on the designing framework and innovative components design.

2) Proposed to the experts to assess 1) content, 2) media, and 3) design thru the learning environment by using the quality assessment form for experts. The data was analyzed by interpreting in order to improve the learning environment quality.

3) Trailed the learning environment by studied the context of use, the most efficient students who learned with the learning environment, the instructional design with learning environment to enhance learners' analytical thinking, and students' opinion towards the learning environment use thru the learning environment-use surveying form, learning environment-opinion surveying form, and interviewing form of context of use. The data was analyzed by interpreting and in descriptive analysis.

5. Research Results

This research was purposive to design and develop the learning environment to enhance learners' analytical thinking which the results were presented in 2 processes as Design and Development processes. The designing components comprised 1) Problem Base, 2) Resource, 3) Collaborative, 4) Analytical Thinking Center, 5) Scaffolding, and 6) Coaching which each detailed were as follows:

5.1 Problem Base

To evoke the learners' schema. The design based on Cognitive constructivist of Jean Piaget (Piaget, 1964) which keys is the active learners who construct knowledge. This believes that when the learners have cognitive conflict or in disequilibrium condition, they try to adjust their Cognitive structuring into Equilibrium by the way of Assimilation or Accommodation. Regards the mentioned principles, they were then becoming the practicing as Problem base where the Enabling context was the situation in authentic context presented in kinds of problem consistent with real context of each related situations. This helped the learners to be able to refer or connect with their own prior experience. Also, the components design as cognitive constructivist as can be seen in Figure 1-2.

Figure 1. Screen of learning environment to enhance learners' analytical thinking.
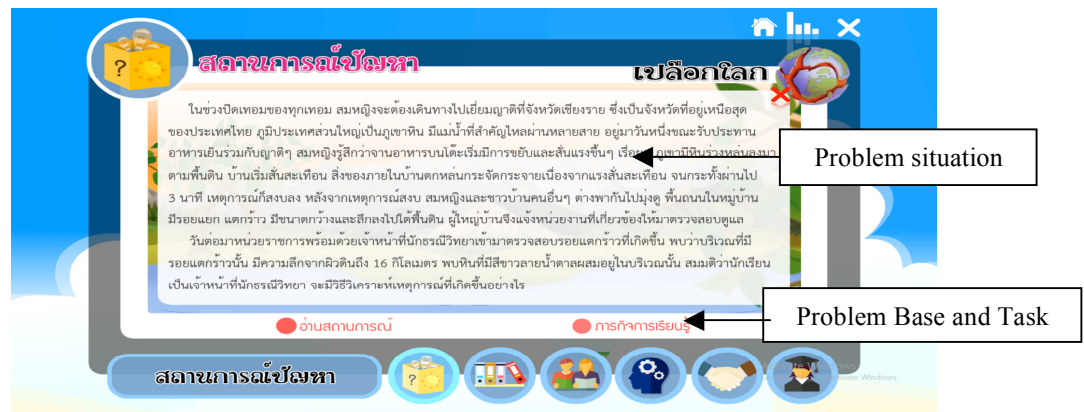

Figure 2. Problem Base

5.2 Resource

It was the collections of learning resources where the learners could use in solving a problem they confronted in Problem base. The design resource based on Information processing theory (Klausmeier, 1985) and SOI Model (Mayer, 1999) which enables understanding and selecting of cognitive processes in well designed as concept maps which presented the whole content thru graphic and animation in order to demonstrate object along with the various kinds of information in many resources presented shapes, highlighted important information with colors, sizes, underline, and several conceptual maps to demonstrated the relations of the information. Importantly, the learning resources as can be seen in Figure 3.

Figure 3. Resource

5.3 Collaboration

It was the component designed to elaborate cognitive structure by student's collaboration. They collaborated to solve problems by discussing and exchanging their similar objective of solving, so designed to have Social network as Facebook where they could express opinions and reciprocal their thoughts. This based on Social constructivism of (Vygotsky, 1999), and which was the tool to communicate among students, teachers, and experts at the same point of time as can be seen in Figure 3-4.
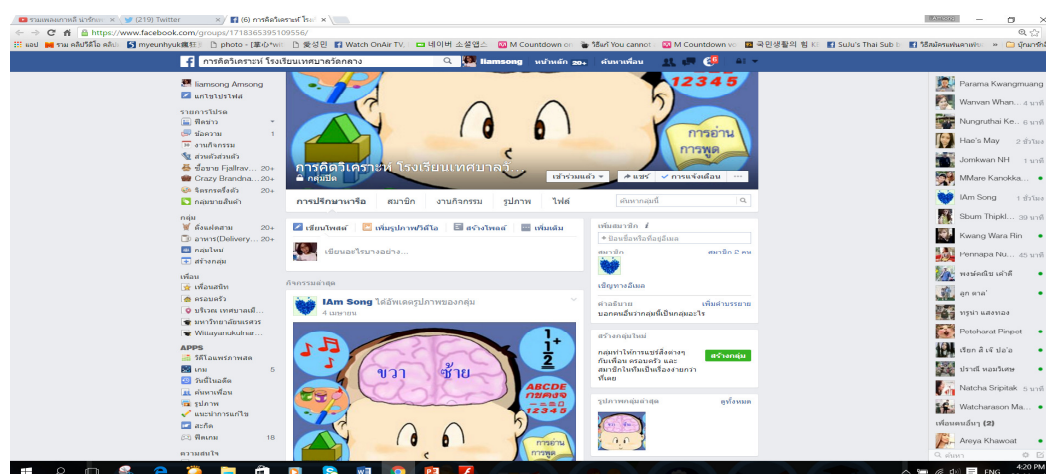

Figure 3. Collaboration

Figure 4. Chat on Facebook Messenger for brainstorming.

5.4 Analytical Thinking Center

It promotes analytical thinking based on analytical thinking (Chaicharoen et al, 2007), in order to help to encourage students to think analytically and solve problems. This was designed into three sub-centers center include: 1) the ability in classifying various factors of one thing or issue, 2) the ability in specifying the significance of cause-effect between those factors, and 3) the ability in organizing various things or issues into different groups. When the students choose a center to promote analytical thinking. The students found learning activities and a practicing of analytical thinking as can be seen in Figure 5-8.

Figure 5. Analytical Thinking Center

Figure 6. The ability in classifying various factors of one thing or issue.

Figure 7. The ability in specifying the significance of cause-effect between those factors.

Figure 8. The ability in organizing various things or issues into different groups.

5.5 Scaffolding

It was the component to adjust the cognitive equilibrium to enhance problem solving based on Lev Vygotsky which believes that "the students who were in lower of the zone would have to have the Scaffolding which focused to help them in push the effort thru learning more than do a task, also "Zone of proximal development". Based on (Hannafin, Land, and Oliver, 1999) the scaffolding consisted of 1) Conceptual scaffolding, 2) Metacognitive scaffolding, 3) Procedural scaffolding, and 4) Strategic scaffolding as can be seen in Figure 9.

Figure 9. Scaffolding

5.5.1 The Conceptual scaffolding

It helped the students to think conceptually and guided them to access the learning resources or other learning resources. The topics by summarizing the main ideas and designed in conceptual which they could fine the relations of each content as can be seen in Figure 10.

Figure 10. Conceptual scaffolding helped the students to create conceptual thinking.

5.5.2 The Strategic scaffolding

It was the scaffolding of an alternative to support analytical thinking, and strategic planning. This importantly presented in clarifying of required information, assessing of provided resources, and connecting the relations of both prior and new experiences in forms of picture of relationship which the students analyzed and then solved the problems as can be seen in Figure 11.

Figure 11. Strategic scaffolding helped the student thru problem solving.

5.5.3 The Metacognitive scaffolding

It supports students' learning process and guide thinking process in order to solve the problems via suggested strategies as a Guideline based on (Flavell, 1979), including the ability of the learner's existing knowledge. The need for a strategy to solve problems in basic or advanced further. The researchers transform theory into practice by design. The nature of the advice (Guideline) about how to think. Directed learners Monitoring and evaluation of the ideas that help to solve individual problems as can be seen in Figure 12.

Figure 12. Metacognitive scaffolding helped to enhance thinking process.

5.5.4 The Procedural scaffolding

It was the scaffolding to suggest to use resources and tools of the system and its working as can be seen in Figure 13.

Figure 13. Procedural scaffolding suggested the instruction of the cognitive innovation.

5.6 Coaching

The Cognitive Apprenticeship of **(**Collins, Brown and Holum, 1991) was used as a principle to shift them from being novice to expert. Coaching also gave hints when the students made a request. Coaching helped them by monitoring and relating them not to have the misunderstanding in the subject content and instead have the correct understanding immediately. Moreover, coaching could help them to develop to be an expert as can be seen in Figure 14.

Figure 14. Coaching

6. Conclusion and Discussion

Regards the design and development of web-based learning environment, it was found that the components consisted of: 1) Problem Base, 2) Resource 3) Collaborative, 4) Analytical Thinking Center, 5) Scaffolding, and 6) Coaching consisted with the study of Charuni's (2001) that used the constructivism as a basis of design and development of knowledge construction. But this study was different in focusing on learning with learning development in analytical thinking enhancement inside student's cognitive process. Hence, it was found that the designed and developed web-based learning had good quality, consistent with the constructivism theory used as a designing background to enhance analytical thinking in each components. This effected to its efficiency of the constructivism web-based learning which helped to improve learner's learning efficiency then.

Acknowledgements

References

Chaijaroen, S. (2008). *Education Technology: Principle Theories to Practices*, Khon Kaen : Klungnanawittaya.

Chaijaroen, S., Kanjug, I., Samat, C., Wattanachai, S., Pakkothanang, P., and Kong-im., K., (2007). Study of Learners' Thinking Potential of Student studying Instructional Enhancing Thinking Potentiality, *A Research Report, Research Project Report, Research Project of General Research Grant*, Khon Kaen University.

Collins, A., Brown, J. S., Holum, A. 1991. Cognitive apprenticeship: Making thinking visible. *American Educator*, *15*(3), 6(11), 38-46.

Flavell, J. 1979. Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*, 906-911.

Hannafin, M.J., Land, S., and Oliver, K. 1999. Open learning environments: Foundations, methods, and models. In Charles M.Reigeluth (Ed). *Instructional design theories and models: A new paradigm of instructional theory. Volume II*. London: Lawrence Erlbaum Associates.

Klausmeier,K.A. 1985. *Educational phychology (sthed)*. New York : Harper & Row.

Mayer, R. E. 1999. *Designing instruction for constructivist learning*. In C.M. Reigeluth (Ed.), *Instruction-Design Theories and Models (Vol. 2)*: 141-159. Mahwah,NJ: Lawrence Erlbaum Associates.

Piaget, J. 1964. *Part I: Cognitive development in children: Piaget development and learning. Journal of research in science teaching, 2*, 176–186.

Charuni, S. (2011). Design and Development of Constructivist Web-based Learning Enviroment to Enhance Analytical Thinking for Computer Education Leaners. *International e-Learning Conference "Empowering Human Capital Through Online Learning Technology"*. January, 13-14, 2011. The Thailand Cyber University Project under the Commission on Higher Education, Ministry of Education, Thailand.

Vygotsky, L. S. (1999). Consciousness as a problem in the psychology of behavior. In N. N. Veresov (Ed.), *Undiscovered Vygotsky: Etudes on the pre-history of cultural-historical psychology*: 251–281. Frankfurt am Main: Peter Lang Publishers