Learning Management Knowledge Based on Constructivist Approach and Metacognitive Approach for Metacognition Development

Natarika Thongsomnuek[1],
Thiyaporn Kantathanawat[2],
and Paitoon Pimdee[3]
King Mongkut's Institute of Technology Ladkrabang, Thailand
[1]59603039@kmitl.ac.th
[2]kkthiyap@kmitl.ac.th
[3]paitoon.pi@kmitl.ac.th

Abstract - **The objective of this research was to synthesize learning management knowledge based on constructivist approach and metacognitive approach for metacognition development. Documentary research method was implemented to systematically analyze, synthesize, and link all information from various documents and literature reviews. In this research, the research framework was mainly developed to categorize knowledge into different groups. In all, 39 researches were studied. The findings were revealed under 4 different topics, including: 1) background and signification of the research, 2) theory and basic knowledge, 3) learning process, and 4) measurement and evaluation.**

Keywords - **Constructivism, Metacognition**

I. INTRODUCTION

Developing learning ability of learners is an important goal of every educational institution in the world, including Thailand. The aim is to prepare those learners for entering the higher education level. The 21st Century is considered as an innovative and knowledge-based era. It is of importance to ensure that the learners can construct knowledge by themselves. In the past century, traditional learning process has mainly focused on academic content. It might not be sufficient to provide learners the knowledge they need in the 21st century.

A shift from instructor-centered to learner-centered approach or a shift from transmission of knowledge to construction of knowledge becomes more important. It can also be called "Constructivism Theory". Nowadays, it is acknowledged that learning is the process that learners have to actively construct knowledge based on their own individual experiences and learning theory. The learning process will be considered being successful if individual's beliefs and understanding is changed (Cobb, 1994; Fosnot, 1996; Von Glasersfeld, 1989, 1993; Tobin&Tippins, 1993; McRobbie & Tobin, 1997; Thomas, 2002).

Previous researches have shown that the learning process in elementary schools did not focus on self-learning and still lacked of learning process that would encourage learners to develop thinking skills. These problems might arise from one of these following reasons: there might be too many number of learners per class, learners are lacking of basic knowledge, lecture method of teaching, the lack of discussion, seminar, and unavailability of technology. In addition, the evaluation result that was conducted within information technology sections revealed that each module must improve learning methods that would allow learners to develop their thinking skills. The learning process still required the learners to follow the instruction rather than designing learning activities that would allow the learners to create their own knowledge. Also, it was found that majority of instructors did

not understand learning management process that would allow the learners to construct their own knowledge or to develop their own thinking process. They did not know how to conduct activities that would be suitable for the learners.

Learning is a process that takes place inside the learners. The learners are the creator of the knowledge by using interaction between themselves and their past experience (constructivism). Instructors will only act as facilitators who are responsible to create suitable environment to support learning process of the learners. The instructors' role is to help the learners knowing what they think about what they are learning, support reflective thinking on what they have learnt and help them evaluate their learning progress or what can be called "Metacognition". In order to help learners being aware of their own cognitive structure, metacognition is a necessary characteristic and is of significance in the learning process. The instructors must have good knowledge and understand that thinking is a process, not content. Therefore, the instruction to develop thinking process should be a process as well. To do so, theories are needed to be used as a guideline to manage the learning process.

As a result, the researchers decided to study on how to "synthesize knowledge about learning management based on constructivist approach and metacognitive approach for metacognition development" with the aim to explore learning management model for boosting metacognition development.

II. OBJECTIVES OF THE RESEARCH

The objective of this research was to synthesize learning management knowledge based on constructivist approach and metacognitive approach for metacognition development.

III. SCOPE OF THE RESEARCH

In this research entitled "Learning Management Knowledge Based on Constructivist Approach and Metacognitive Approach for Metacognition

Development", the researchers have studied various documents and literature reviews that were related to constructivist approach and metacognitive approach in developing learning management as well as other definitions that related to metacognition development. At least two-third of them must correlate with the research interest. In all, 39 researches were studied.

IV. RESEARCH METHODOLOGY

This research was a qualitative research whereby the documentary research method was used. Related documents, textbooks, journals, articles, and researches were studied. Research procedures are as follows:

1) The researchers collected previous documents and literature reviews about constructivist approach and metacognitive approach for developing learning management. The collected documents and literature reviews were synthesized to find useful data. Purposive sampling technique was used in this research. Documents were selected through the use of keywords such as "constructivist", "metacognition", both in Thai and other languages.

The researchers categorized the study into 2 parts, including: (1) a study on different types of research studies and (2) a study on articles, documents, and other academic papers. The researchers verified the reliability of the data by considering the reliability of institutions and the clarity and accuracy of research methodology. Thai documents written in the years 2007-2018 were selected and used in this research. On the other hand, there is no time frame for English documents. Nevertheless, the documents must be relevant to the topic of the study as it would provide most benefits to the integrative research.

2) The researchers then read and summarized all documents and research studies and started synthesizing the content through the use of systematic analysis. By doing so, the researchers were able to identify the process from the beginning to the end. The key details of the study are as follows.

- Background and signification of the research.

- Theory and basic knowledge.

- Learning process.

- Measurement and evaluation.

3) For the last step of the research, the researchers concluded concept and practical guidelines to explain learning management model that was developed based on constructivist approach and metacognitive approach for metacognition development. Recommendations were also given.

For the analysis, definitions and explanation of keywords were used. The researchers gathered and synthesized all the work before summarizing all knowledge gained from the research.

V. CONCLUSIONS AND DISCUSSION

For the review of Thai literatures about developing learning management model based on constructivist approach and metacognitive approach for metacognition development, 39 research documents written in the years 2007-2018 were used.

For the review of English literatures, there were more limitations than Thai literatures. The main problem was about reliability of the research. There was no reference to refer as the researchers got the documents from electronic information database of academic institutions in other countries. Consequently, the researchers did not set the time frame of the research, but carefully selected only the documents that were relevant to the topic of the study as it would provide most benefits to the integrative research.

The data sources, type of data, and number of data were summarized in the form of a table. The details are shown in Table I.

TABLE I
DATA SOURCES, TYPE OF DATA, AND NUMBER OF DATA USED IN THIS RESEARCH

Data Sources	Type of Data	Number	Total
Thailand	1. Research	10	20
	2. Article/ Textbook/Book	10	
Other countries	1. Research	-	
	2. Article/ Textbook/Book	19	19

In order to see the overview of the literature reviews, the researchers had collected, analyzed, synthesized all data in order to summarize knowledge gained and provided recommendations in this research. The details of the research are as follows:

A. *Background and Signification of the Research*

According to the past literature reviews, it can be concluded that a shift from instructor-centered to learner-centered approach or a shift from transmission of knowledge to construction of knowledge are becoming more important. It can also be called Constructivism Theory. It is a theory that focuses on the construction of knowledge by the learners. Learning is considered as a process that occurs in the thinking process of the learners (Chantharanuwong & Sintoovongse, 2014).

Researchers and scholars similarly defined constructivism as a theory that allows the learners to construct knowledge for themselves. Creating suitable environment that is similar to the reality will trigger the construction of new knowledge from the existing one. The suitable environment will support self-learning process of the learners (Simmatun, 2009; Samat, 2009; Chaijaroen, 2011; Nachairit, 2007; Perkins, 1992; Von Glaswrsfeld, 1993; Cobb, 1994; Fosnot, 1996).

According to Gunstone (1992), beliefs and recognition of learners towards teaching and learning are main learning obstacles. If the learners are able to learn things by themselves through various learning methods, they will be able to develop learning goals, plan and control their own learning process. Also, they will be able to use their own judgment in

consideration and able to analyze related factors that will help them accomplishing their learning goals. This concept was influenced by the work of Flavell (1976) who is both researcher and academic. He proposed a formal model of metacognitive and claimed that "With metacognitive, the learners will become better learners in all area of expertise".

As a result, theory that helps the learners having the right thinking process and to motivate learners to generate their own knowledge is the "Metacognitive Theory".

B. Theory and Basic Knowledge

Constructivist theory asserts that learning is likely to be a process of constructing rather than acquiring knowledge. As such, the aim of the instruction is about supporting the knowledge constructed rather than transferring the knowledge. It can be said that the constructivist theory focuses on creating the right knowledge for the individual and the creation of suitable environment is of importance for the interpretation of the knowledge (Duffy & Cunningham, 1996). Jean Piaget (a Swiss psychologist) and Lev Vygotsky (a Russian psychologist) suggested that there are two basic types of the learning theories, including Cognitive constructivism and Social constructivism (Chaijaroen, 2011).

Constructivism is the process that the learners have to construct knowledge by themselves. Interpretation of knowledge is constructed from the individual's belief on the basis that the new knowledge is built upon existing knowledge (Treagust, 2007). This will help developing and promoting learning process of the learners while encouraging them to further learn and investigate more scientific knowledge.

Metacognition is a self-regulatory mechanism to control processes in the brain (Eggen & Kauchak, 1996). In other word, metacognition refers to knowledge about cognition, control of cognition, and awareness towards cognition (Marzano et al., 1988). Metacognition knowledge refers to knowledge about the learning process. It consists of what learners know, how they get that knowledge, how they store those knowledge, what process they use to store those knowledge, when and how they should use that process, why they have to use that process, and their ability to know their expertise. On the other hand, metacognition experience refers to one's ability to control, plan, and check their thought (Flavell, 1985).

C. Learning Process

Constructivism is a learning process that allows the learners to construct knowledge from collaborative problem solving. The learning process will start when the cognitive conflict occurs. It is normally happened when the previous experiences or knowledge are unable to solve that problem. More information is needed to be investigated until empirical evidence that can eliminate the conflict is found. This is to ensure that the learners will achieve cognitive equilibrium through assimilation and accommodation or what can be called "Cognitive restructuring" (Saduakkan, 2000; Chaijaroen, 2011).

In other word, the instructors should provide learners with the learning environment that best facilitates self-learning while the learners are responsible to construct their own knowledge. In order to successfully construct new knowledge, the learners have to pass through cognitive restructuring process. The aims are to find a better reasonable explanation to the situation and to be able to explain a new experience that they are about to receive (von Glaserefeld, 1996). Therefore, thinking process is considered as a tool for creating knowledge and it is an important step in the learner's learning process.

Knowledge construction requires thinking process. The instructors' role is to help the learners knowing what they think about what they have learned, reflecting results, advising them how they can apply that knowledge in their daily life, and help them checking their progress. All of these processes are known as Metacognition. In order to make the learners aware of the cognitive restructuring, Metacognition is a necessary characteristic and

is of significance in the learning process.

D. Measurement and Evaluation

Evaluation of metacognition components can be categorized into 2 parts, including the evaluation of metacognitive knowledge and the evaluation of metacognitive experience. The metacognitive experience consists of 2 parts as well, including metacognitive control and metacognitive awareness.

1) Evaluation of Metacognitive Knowledge

It is the evaluation on what the learners give the meaning to. It includes facts, beliefs, opinions, generalizations, theories, hypotheses and attitudes towards something (Anderson, 1990). For example, what is learning? / what is thinking? / and what factors are likely to influence their ability to do or play that role?

It also includes knowledge towards something, someone and themselves. The evaluation of metacognitive knowledge includes the 3 components of the metacognitive knowledge, including: (1) Declarative knowledge, (2) Procedural knowledge, and (3) Conditional knowledge. Evaluation criteria are indicated in the following table:

TABLE II
EVALUATION OF METACOGNITIVE KNOWLEDGE

Type of Knowledge	Definition
(1) Declarative knowledge	It is the knowledge on what the learners give the meaning to. For example, what is learning?, what is thinking?, and what factors are likely to influence their ability to do or play that role?
(2) Procedural knowledge	Learners know that they have received knowledge from various strategies and methods. For example, I learn from… I think by… I think when I…I learn by…etc.
(3) Conditional knowledge	It refers to the question of when and why a certain strategy or procedure should be used.It is a unique ability of an individual to learn in a particular situation as well as for adapting these strategies to new situations. For example, I use this strategy when … I think like this because…I do not use this learning strategy because…

Below are the questions that are often used to evaluate metacognitive knowledge.

TABLE III
EXAMPLES OF QUESTIONS THAT ARE OFTEN USED TO EVALUATE METACOGNITIVE KNOWLEDGE

Types of Answers	Questions/Answers
(1) Declarative knowledge	What is learning? Answering based on learners 'understanding………………
(2) Procedural knowledge	Let the learners explain the technique, method or process they use to acquire such knowledge. For example, taking a note, using keywords, *skipping unnecessary* detail or words that are not vital to meaning, using pictures and symbols, summarizing only main details, or sorting the data………………….. Please describe the method you used thoroughly……………………………
(3) Conditional knowledge	When do you decide to use such method? ……………………… How do you use such method? ………………… Why do you choose to use such method? …………..

2) Evaluation of Metacognitive Experience

The evaluation of metacognitive experience includes the 2 components of the metacognitive experience, including metacognitive control and metacognitive awareness. Scoring Rubrics can be used in the evaluation, as shown in the following table.

TABLE IV
METACOGNITIVE CONTROL AND AWARENESS SCORING RUBRICS

Strategy	Quality Level	Behavior/Expression/Opinion
Monitoring and Maintaining	5	= Conducting activity review, exchanging knowledge with other learners to collect data, Setting up goals, Performing duties as assigned by the group, Following the steps to perform assigned duties, Writing the feeling about learning process, Designing and following next step precisely, Explaining thinking process, Writing out problems and mistakes from learning, Knowing how to eliminate such problems and mistakes from learning
	4	= Conducting activity review, exchanging knowledge with other learners to collect data, Setting up goals, Performing duties as assigned by the group, Following the steps to perform assigned duties, Writing the feeling about learning process, Designing and following next step precisely, but not explaining thinking process, not writing out problems and mistakes from learning, not knowing how to eliminate such problems and mistakes from learning
	3	= Conducting activity review, exchanging knowledge with other learners to collect data, Setting up goals, Performing duties as assigned by the group, Following the steps to perform assigned duties, Writing the feeling about learning process, but cannot designing and following next step precisely
	2	= Conducting activity review, exchanging knowledge with other learners to collect data
	1	= Conducting some activity review
Awareness	5	= Aware of what you are learning or doing, Aware of what you are thinking, Aware what you are thinking and doing in learning, Aware that you are improving behavior in learning, Aware of your strength and weakness, Aware of what is happening and its result
	4	= Aware of what you are learning or doing, Aware of what you are thinking, Aware what you are thinking and doing in learning, Aware that you are improving behavior in learning, Aware of your strength and weakness
	3	= Aware of what you are learning or doing, Aware of what you are thinking, Aware what you are thinking and doing in learning, Aware that you are improving behavior in learning
	2	= Aware of what you are learning or doing, Aware of what you are thinking, Aware what you are thinking and doing in learning
	1	= Aware of what you are learning or doing

For the evaluation of 2 types of metacognition, the researchers synthesized from the research done by Anderson, (1990), Thomas & McRobbie, (2001), Sintoovongse (2007), Chantharanuwong & Sintoovongse, (2014), Klangmani, (2010).

VI. RECOMMENDATIONS

The finding revealed that several research methodologies were used to identify metacognitive thoughts. Those methodologies were used to confirm the findings in a variety of sophisticated ways. All researches were done to collect and analyze data. Previously, the researches on this field were done in different contexts and with different methodologies. There was no clear research framework. Triangulation technique was used in these researches to ensure that the findings would be reliable. The aims of these researches were to understand reality of learners' metacognition and problems that the learners and instructors had to encounter. It is of importance to find evidence showing that the learners are still lacking of metacognition and metacognition strategies.

Research methodology that is of importance in this field of research is a mixed method. It is the combination of quantitative method and qualitative method (Guba & Lincoln, 1989). Metacognition is an activity that occurs inside individual and it cannot be seen from the outside. Therefore, majority of the evaluation was conducted on the external expression of the individual. As such, instruction of the instructors and learning of the learners are derived from personal feeling after they have interaction with something in their context. This research field focuses on making the learners the center of the learning process and trying to understand thought that comes from the inside of the learners through the use of various research instrument. Data collection in this research field is about finding evidence

and develops it into useful information for later interpretation.

Complex research design is important for this research field. In addition, context variables such as an inspiration of the learners and instructors, nature of the module, learning process, problem solving process, time spent on activities, media effect, and inappropriate learning process are also important (Gunstone, White, Fensham, 1988). All these things affect metacognition development as well as other thinking process (Thomas, 2002). Therefore, it is necessary to use various types of research instruments in this research field so as to explain and confirm research results. This is to get closest to the facts, understand the real thinking process of the learners, and the problems that have effect on both learners and instructors.

This type of research requires observation. Therefore, the researchers need to get insight from the real sources of information. White (1992) said that in order to develop metacognition in classroom, the instructor is the only one who can do so, not other personnel or researchers. Nevertheless, major problems that are normally found is that there are other researchers who are trying to train the instructors or trying to use other tools and programs to meet their needs. The best way to solve this problem is to make the researchers being the instructors themselves.

Most importantly, the researchers must adhere to the idea that the researchers are instructors who want to provide best knowledge to maximize the benefit for the learners.

VII. ACKNOWLEDGMENT

REFERENCES

(Arranged in the order of citation in the same fashion as the case of Footnotes.)

[1] Samat, C. (2009). "Design and Development of Constructivist Web-Based Learning Environment Model To Enhance Creative Thinking for Higher Education Students". Doctor of Philosophy, Khon Kaen University.

[2] Nachairit, D. (2007). "The Outcomes of Learning from Web-based Multimedia Courseware Based on Constructivist Concept Entitled Application of Educational Technology in the Classroom of Undergraduate Students Majoring Educational Technology and Communication". Master of Education Program in Educational Technology, Mahasarakham University.

[3] Klangmani, R. (2010). "The development of grade 5 students' Metacognitive strategies in learning about force and pressure through Predict-Observe-Explain (POE)". Master of Education Program in Science Education, Graduate School, Khon Kaen University.

[4] Chaijaroen, S. (2011). "Education technology: Principles theories to practices (2nd Ed.)". Khon Kaen: Klangnanavittaya Press.

[5] Chaijaroen, S. (2014). "Instructional Design: Principles and Theorie". Khon Kaen: Anna Offset.

[6] Khammani, T. (2011). "Teaching Technique: Knowledge for Effective Learning Management". Bangkok: Chulalongkorn University Printing House.

[7] Simmatun, P. (2009). "Model of Activities Web-based Collaborative Instructional Model based on Constructivist Theory for Undergraduate Students". Doctor of Philosophy Programme in Computer Science, King Mongkut's University of Technology North Bangkok.

[8] Chantharanuwong, W. and Sintoovongse, K. (2014). "Metacognition: Learning management model for learners' thinking development". Khon Kaen: Office of the Basic Education Commission.

[9] Chaikan, W. (2007). "The use of Metacognitive strategies on learning skills development in chemistry of Matthayomsuksa five students". Master of Education Program in Science Education, Graduate School, Khon Kaen University.

[10] Anderson, J.R. (1990). "The adaptive character of thought". Hillsdale, NJ: Lawrence Erlbaum Associates.

[11] Cobb, P. (1994). "Where is the mind? Constructivist and sociocultural perspectives on mathematical development". Education Researcher, Vol. 23(7), pp. 13-20.

[12] Duffy, T.M. and Cunningham, D.J. (1996). "Constructivism: Implications for the Design and Delivery of Instruction". In Jonassen, D.H. (Ed.), Handbook of Research for Educational Communications and Technology, NY: Macmillan Library Reference, USA.

[13] Eggen, P. and Kauchak, D. (1996). "Strategies for Teachers, Teaching Content and Thinking Skills". Needham Height, MA: Allyn and Bacon.

[14] Flavell, J.H. (1976). "Metacognitive aspects of problem solving". In Resnick, L.B. (Ed.), Hikksdale, NJ: John Wiley, pp. 231-235.

[15] Flavell, J.H. "Cognitive development". Englewood Cliffs, NJ: Prentice-Hall.

[16] Fosnot, C.T. (1996). "Constructivism: A psychological theory of learning". In Fosnot, C.T. (Ed.), Constructivism: Theory, perspectives and practice, New York: Teachers College Press, pp. 8-33.

[17] Guba, E.G. and Lincoln, Y.S. "Fourth generation evaluation". Englewood Cliffs, New Jersey: Prentice – Hall.

[18] Gunstone, R.F. (1992). "Constructivism and metacognition: Theoretical issues and classroom studies". In Duit, R., Goldberg, F., and Niedderer, H. (Eds.), Research in physics learning: Theoretical issues and empirical studies, FDR: Institute for science Education, pp.129-140.

[19] Gunstone, R.F., White, R.T., and Fensham, P.J. (1988). "Developments in style and purpose of esearch on the learning of science". Journal of Research in Science Teaching, pp. 513-529.

[20] Marzano, R.J., Brandt, R.S., Hughes, C. S., Jones, B.F., Preseisen, B.Z., Rankin, S.C., and Suhor, C. (1988). "Dimentions of thinking: A framework for curriculum and instruction". Alexandria, VA: Association for Supervision and Curriculum Development.

[21] McRobbie, C. and Tobin, K. (1997). "A social constructivist perspective on learning environments". International Journal of Science Education.

[22] David, P. (1992). "Smart Schools: Better Thinking and Learning for Every Child".

[23] Tobin, K. and Tippins, D. (1993). "Constructivism as a referent lean". In Tobin, K. (Ed.), How student lean, Washinton, DC: American Association for the Advancement of Science Press.

[24] Thomas, G.P. (2002). "The social mediation of metacognition". In Mclnerny, D. and Van Etten, S. (Eds.), Research on sociocultural influences on motivation and learning, Greenwich, Ct: Information Age Publishing, Vol. 2, pp. 225-247.

[25] Treagust, D.F. and Chandrasegaran, A.L. (2007). "The Taiwan National Science Concept Learning Study in an International Perspective". International Journal of Science Education, pp. 391-404.

[26] Von Glasersfeld, E. (1993). "Questions and answers about radical constructivism". In Tobin, K. (Ed.), The practice of constructivism in science education, Washinton, DC: American Association for the Advancement of Science Press.

[27] Von Glasersfeld, E. (1996). "Aspects of constructivism". In Fotnot, C.T. (Ed.), Constructivism: Theory, perspectives and practice, New York: Teachers College Press.

[28] White, R.T. (1992). "Implications of recent research on learning for curriculum and assessment". Journal of Curriculum Studies, Vol. 24(2), pp. 153-164.

[29] Kantathanawat, T. (2013). "Knowledge to development of strength of community in tripartite preventing and solving drug problem". Journal of Industrial Education, Vol. 12(2).