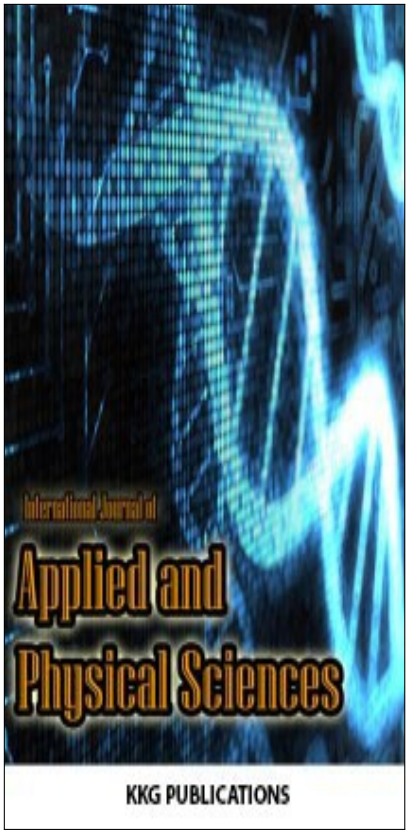

Key Knowledge Generation
Publication details, including instructions for author and subscription information:
http://kkgpublications.com/applied-sciences/

The Framework of Learning Innovation to Enhance Knowledge Construction and Scientific Thinking for Students in Basic Education

JITTIMA THISUWAN [1], KANJANAWADEE PRASITTISA [2], PARAMA KWANGMUANG [3]

[1, 2] Division of Science Education, Faculty of Education, Nakhon Phanom University, Nakhon Phanom, 48000, Thailand
[3] Division of Computer Education, Faculty of Education, Nakhon Phanom University, Nakhon Phanom, 48000, Thailand

Published online: 20 November 2017

To cite this article: J. Thisuwan, K. Prasittisa and P. Kwangmuang, "The framework of learning innovation to enhance knowledge construction and scientific thinking for students in basic education," *International Journal of Applied and Physical Sciences,* vol. 3, no. 3, pp. 68-74, 2017. DOI: https://dx.doi.org/10.20469/ijaps.3.50003-3

To link to this article: https://kkgpublications.com/wp-content/uploads/2018/09/IJAPS.3.50003-3.pdf

PLEASE SCROLL DOWN FOR ARTICLE

International Journal of Applied and Physical Sciences
2017, 3(3): 68-74

IJAPS

THE FRAMEWORK OF LEARNING INNOVATION TO ENHANCE KNOWLEDGE CONSTRUCTION AND SCIENTIFIC THINKING FOR STUDENTS IN BASIC EDUCATION

JITTIMA THISUWAN [1]*, KANJANAWADEE PRASITTISA [2], PARAMA KWANGMUANG [3]

[1, 2] Division of Science Education, Faculty of Education, Nakhon Phanom University, Nakhon Phanom, 48000, Thailand

[3] Division of Computer Education, Faculty of Education, Nakhon Phanom University, Nakhon Phanom, 48000, Thailand

Keywords:
Learning Innovation
Knowledge Construction
Scientific Thinking
Theoretical Framework
Designing Framework

Received: 13 April 2017
Accepted: 02 October 2017
Published: 20 November 2017

Abstract. This research aimed to synthesize the framework of learning innovation framework to enhance knowledge construction and scientific thinking for students in basic education. The research designs of this study were document analysis and survey. The target group was the three experts reviewed document, theoretical and design framework. The data were collected by qualitative method and analyzed using summary interpreting. The results show that: the synthesis of learning innovation framework to enrich knowledge construction and scientific thinking for pupils in basic education was the theoretical framework consist of three foundation bases as the following; (1) context base, (2) psychological and pedagogies base, and (3) technological and media theory base. The designing framework consisted of four foundation bases as the following; (1) to activate the cognitive structure innovation, enhancement knowledge construction, and scientific thinking; (2) to support an adjustment of conflict cognitive innovation and enhance knowledge construction and scientific thinking; (3) to provide the cognitive structure and innovation to enhance knowledge construction and scientific thinking; and (4) to assist the enlargement knowledge construction and scientific thinking. The foundation bases consist of seven essential elements: this framework was reviewed and evaluated by experts who assume that effective and implementable knowledge construction and scientific thinking.

INTRODUCTION

Thailand is facing a rapid change in information technology and telecommunications. Thus, there is a flux of foreign cultures into Thailand. The country faced the problem of a crisis of morals, values, and behavior change. Moreover, both scientific and technological development situations in Thailand is at its low level. If technology on the internet network is practically used for learning and teaching as a smart tool, learners will be motivated to intelligently learn and effectively use technology by creating a learning environment that promotes learning. Thus, it will affect everyone in society to learn anywhere and anytime and help Thailand to become a society of learning. Also, it conforms to the learning that is mainly focused on learners and serves different needs. The kind of learning will help the country to wisely adapt to the learning society, and be consistent with, [1] and [2]. It gives out the importance of human development in the country, determines educational management principles which concentrate on learners the most. Besides, there is the need of promoting the development of natural knowledge and fulfilling ability and potential and learning management. Hence, learners can get to practice skills, thinking processes, management, ways to handle situations, and how to apply knowledge to prevent and solve problems. Learning management following such guidelines requires a change of learning management by holding learning activities that engage students and emphasize the development of thinking processes, planning, practicing, researching, collecting information in different ways from a variety of sources of learning. Students should monitor data analysis and have mutual interactions.

Furthermore, in scientific learning, teachers should focus on motivating students to mostly learn and discover answers themselves. Learning occurs through the process of creating knowledge. As [3], [4], [5] suggested new ideas about the nature of science that it is the knowledge that is made up of an assortment of humans and of society and scientific knowledge is occurred from the knowledge of ones happened under conditions, and social contexts of their lives. Humans use the process called a scientific inquiry, solutions, and information searching to create new knowledge more likely all the time. Scientific knowledge must be explained and verified to be used as references to support or disprove information from a new discovery or even the same old data can cause conflicts. If scientists interpret by different concepts or methods, scientific knowledge can probably change [6], [7]. So, the concept of

*Corresponding author: Jittima Thisuwan
†Email: thisuwan@npu.ac.th

teaching and learning science, according to the [8], [9] thus is set for a link to the curriculum content and process concepts that are universal. There should be the flexibility to meet a variety of students' different interests and skills. It encourages all students to develop their thinking process, the discovery of knowledge, problem solving, experiments in a laboratory, studying from learning sources, and also the exchange of experiences while participating in activities. Students will be able to search for knowledge, solve problems, develop higher-order thinking, and invent creative knowledge. It is found that to encourage students to learn science, students must be able to use scientific thinking processes which are the cognitive processes to solve problems by thinking rationally in solving scientific problems, and so on.

From the reasons and the importance mentioned above, the teaching of science would motivate students to learn and there would be intellectual, thinking development which includes ways to think rationally, and think and analyze, have important skills in searching for knowledge, solve problems systematically, and make decisions using a variety of data and verifiable testimonies. Moreover, students would have good abilities, be up-to-date with scientific and technological developments, keep pace with changes in science and technology, and be the people who are constantly creating new knowledge.

For that reason, it is necessary to develop a curriculum that promotes scientific thinking and knowledge of the students. Researchers realized the importance and necessity of developing learning innovation to enhance knowledge construction and scientific thinking for students in basic education, based on the development of the synthesis of the theoretical framework, which is from studying related theories and research, into the concept of designing framework and a synthetic component of the next innovation. This is to promote scientific thinking to come up with students by using it as a fundamental for the design of learning Innovation to promote scientific thinking that can be applied to computer technology media which is like a cognitive friend of learners later.

Objectives

To synthesize the theoretical framework and designing framework for the learning innovation to enhance knowledge construction and scientific thinking for students in basic education.

Research Methodology

This research employed various research types as document analysis and survey by using qualitative data collection.

Target Group

The three experts for examining of document analysis and designing framework for the learning innovation to enhance knowledge construction and scientific thinking for students in basic education.

Research Instruments

The instruments used to collect data were 1) the record form of verifying and document analyzing, 2) the recording form of theoretical framework synthesis, 3) the recording form of designing framework synthesis, and 4) the expert assessment form for the designing framework of the learning innovation to enhance knowledge construction and scientific thinking for students in basic education.

Data Collection

The data was collected by the following:

1. Literature review: studied and analyzed the theories and principles of those designing on learning innovation to enhance knowledge construction and scientific thinking for students in basic education which based on SOI model [10], cognitive apprenticeship [11] to enhance scientific thinking, constructivism to construct knowledge [12], [13], [14] and media attribute and media symbol system of multimedia to be used as the fundamental and recorded in the record form.

2. Synthesized the theoretical framework from the literature review in the above-studied areas in no. 1 which synthesized into (1) context base, (2) psychological and pedagogies base, and (3) technological and media theory base by using the recording form of theoretical framework synthesis and proposed to the expert to examine.

3. Synthesized the designing framework based on the theoretical framework which emphasized on knowledge construction and scientific thinking for students in basic education.

4. Synthesized the components of learning innovation based on the designing framework in no. 3.

5. Both designing framework and learning innovation components were proposed to the experts to examine the consistency for both by criticizing and evaluating for the assessment results to be used to improve the innovation.

Data Analysis

The researcher will analyze the data by synthesis theoretical and designing frameworks, analyze the data by analysis in descriptive analysis and interpreting.

RESULTS

The results of the conceptual framework of the learning innovation to enhance knowledge construction and scientific thinking for students in basic education comprised theoretical and designing frameworks as the following:

1. The Theoretical Framework of the Learning Innovation to Enhance Knowledge Construction and Scientific Thinking for Students in Basic Education

The study of theories and principles of the learning innovation to enhance knowledge construction and scientific thinking for students in basic education to be used in the synthesis of theoretical and designing frameworks was found three important bases as

1.1) Contextual Base: The researcher studied with five school directors, one-four of teachers responsible for instruction of the science learning substance for grades seven through nine, and the respective student bodies within those classes under the office of secondary educational service area 22 by surveying and interviewing towards learning which enhance knowledge construction and scientific thinking in the topic of learning experience group, instructional design, and learning which enhance knowledge construction and scientific thinking. This was revealed that most schools handled with junior high school, implemented in an academic following implementation annual plan to encourage and promote educational projects such as exhibitions of academic outcomes and projects of learning and instructional design based on the student-centered. For learning in the scientific area, there were the uses of demonstrations and excursions, discovery learning, group learning, and experiments, but lacked materials and equipment used in scientific experiments. The most teaching style used was lecturing which there was no instructional design that promoted knowledge construction and scientific thinking in school implementation plan. Also, lecturing was the way of rote learning which focused on content to only memorize. But for the students' learning activities that promote knowledge construction and scientific thinking was not clearly shown.

Regards the above results, the research then used to design the learning innovation following the framework of knowledge construction and scientific thinking for each innovation components.

1.2) Psychological and pedagogies base: The psychological base based on two important theories as 1) constructivist to enhance knowledge construction and 2) cognitivism to enhance scientific thinking which both mainly aimed to enhance the learners to have knowledge construction and scientific thinking. Also, the pedagogies base as constructivist learning models based on 1) open learning environments [14], 2) SOI model [10], and 3) cognitive apprenticeship [11].

1.3) Technological and media theory base: The designing and developing of learning innovation was studied by the researcher through multimedia learning media symbol system as the fundamental for designing and developing of learning innovation.

Therefore, this study was recognized the importance of the development of innovative learning by using principle in a learning process that promotes human cognitive process integrated with information processing theory, media attributes as shown the relationship among above five fundamental bases in below theoretical framework in Figure 1.

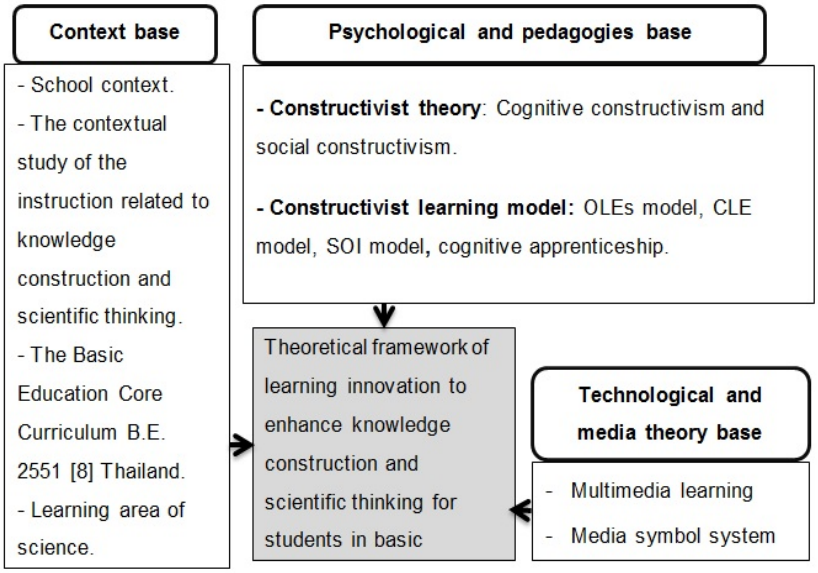

Fig. 1 . Theoretical framework of learning innovation to enhance knowledge construction and scientific thinking for students in basic education

2. The designing framework of the learning innovation to enhance knowledge construction and scientific thinking for students in basic education

The theoretical framework was used as a fundamental to synthesize the designing framework for the learning innovation from theories to practices into four learning innovation components to enhance knowledge construction and scientific thinking as the following:

2.1) To activate the cognitive structure innovation, enhancement knowledge construction, and scientific thinking. This based on constructivism and cognitivism theories to provoke the learners to have a cognitive conflict by problems into externally imposed by presenting the problems in authentic and related situations to make them be able to connect or refer to their own prior experiences. This was design as problem base with tasks to enhance knowledge construction and scientific thinking based on constructivism [12], [13], [14], [15] and scientific thinking of [16]. It consisted of 1) inquiry, 2) analysis, 3) inference, and 4) argument. Thus, the synthesis of designing framework in the designing of the learning innovation to enhance knowledge construction and scientific thinking for students in basic education was created problem base or hereby called "case study center".

2.2) To support an adjustment of conflict cognitive innovation and enhance knowledge construction and scientific thinking. Once the learners had been encouraged by the procedures of schema and cognitive conflict through problem-based and learning tasks, they then attempted to have cognitive structuring or get into equilibrium to construct a new knowledge. To support an adjustment of their cognitive structuring to make them discover information and answers and then construct knowledge and scientific thinking, the researchers assigned the students to start the study from case study center which the center was similar to the content and the center motivated the learner's cognitive disequilibrium. And the tasks to promote scientific thinking influenced them to have internal motivation to make discovery learning to adjust their conflict cognitively via resource center. As that so, the researcher's designed resource center that full of resources and information they could use to solve problems in case study center they confronted firstly. SOI model [10] in constructivist theory was used to design and categorized such information into groups in order them to be able to integrate knowledge successfully.

2.3) To provide the cognitive structure and innovation to enhance knowledge construction and scientific thinking. Regards knowledge construction based on constructivist, it highlights on personal knowledge construction which its process could produce limited knowledge, incomplete and misunderstandable knowledge. The learners might not be able to construct knowledge by themselves. The collaborative problem solving was used to help them to adjust their cognition restructuring which based on social constructivism [17]. Hence, the designing was aimed to enhance the learners to have collaboration with social interaction or groups by using concepts sharing which reduced or fixed the misunderstanding. Also, it enhanced them to have multiple perspectives. It required having knowledge sharing component to enhance them to have collaborative. Furthermore, the understanding of each problem was the way to evoke their experience for such problem and construct its problem patterns. Some students who lacked experience would face the difficulties to solve the problem [15]. So, the component of cognitive innovation design hence was opened for them to access the experiences related to the problem which they could refer or connect to their own contexts. The related cased helped them to learn and apply for solving a new problem that likes the cases. This was designed to have problem solving and explanations of such solving with reasons in related case center according to the principle of Constructivist Learning Environment model (CLEs) [15]. In addition, scientific thinking was the skill required both theories and evidence to work together, which relies on self-regulation for finding answers, discovery learning, data analysis, opinion conclusion, and reasoning supporting both themselves and others in order to have an understanding and scientific conceptual thinking. This was really important for the learner's development to have a mental model in what they were learning which led them make the relationship with their own theories and adjust such theories by themselves. It required discovery learning, analytical thinking, reasoning and considering, all for making a decision especially in scientific learning. The scientific learning importantly called for the studying on natural truth, new discovery, and scientific learning development which led to the designing of "lab center" component based on [16]. This comprised 1) inquiry, 2) analysis, 3) inference, and 4) argument as fundamentals for scientific learning development and discovery learning.

2.4) To assist the enlargement of knowledge construction and scientific thinking based on [17]. This believes the restrictions on the development or called zone of proximal development that if the learners were under the zone they must be assisted in learning as a guidance and support of the cognitive restructuring and enhancing of knowledge construction and scientific thinking [14]. Therefore, the synthesis of designing framework for the learning innovation to enhance knowledge construction and scientific thinking for students in basic education from theories to practice was designed as "scaffolding center" component which consisted of 1) Conceptual scaf-

folding to help the learners to have conceptual thinking and to guide or give a hint for them in order to be able to access learning resources or other learning materials; the researcher designed the connections to show each topic relationship by summarizing and presenting in charts which helped them to easily remember the key content, 2) Metacognitive scaffolding to support their learning processes by guiding them how to think while learning, providing them the thinking procedures to be used to solve problems with learning resources and possible strategies in forms of a guideline in order them to be able to have self-direct and self-regulation to assess each learner's solving processes, 3) procedural scaffolding was scaffolding used to guide them how to use learning resources and materials concerning its characters and working system, and 4) Strategic scaffolding to provide them an alternative which possibly useful to support analytical thinking, strategic planning, and strategic thinking while learning; this mainly on the distinguishing of required information, provided-resource evaluation, and connection of prior and new knowledge by designing on problem solving and graphic of problem solving processes to keep them out of misunderstand through self-knowledge construction. Also, cognitive apprenticeship [11] assisted the learners to have the ability to work with complex cognitive tasks by expert models and unobvious cognitive processes. Thus, the synthesis of designing framework in learning innovation to enhance knowledge construction and scientific thinking for students in basic education from theories to practices was designed as consult center component. The good practicing must offer the learners to confront the demonstration or expert sample with explanations especially in scientific learning which required practicing with guideline and coaching. This could help them to know how to do, and more importantly, coaching supported the monitoring and mentoring learners to have the right understanding.

The theoretical framework was synthesized to designing framework as theories to practices as shown in Figure 2.

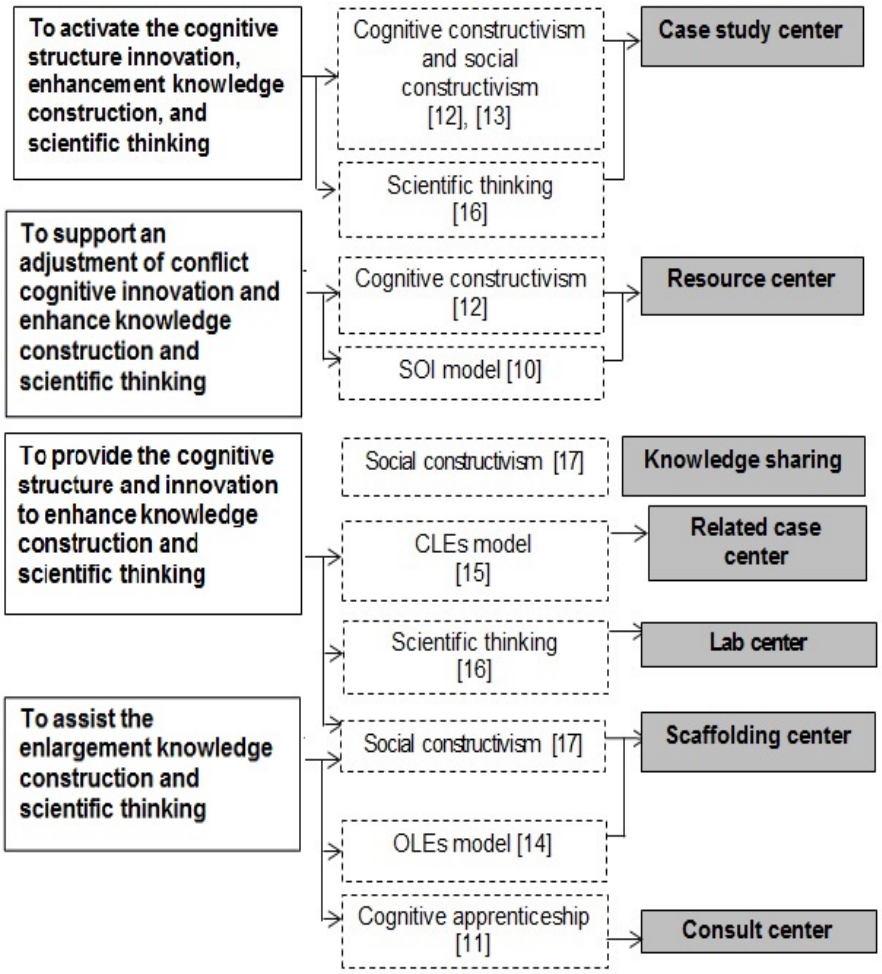

Fig. 2 . Designing framework of learning innovation to enhance knowledge construction and scientific thinking for students in basic education

The synthesis of designing framework based on theoretical framework resulted in the seven components as 1) case study center, 2) resource center, 3) scaffolding center, 4) related case center, 5) lab center, 6) knowledge sharing, and 7) consult center as shown in Figure 3.

The evaluation of designing framework of the learning innovation to enhance knowledge construction and scientific thinking for students in basic education expert reviewer to examine the theoretical validity in designing was found that the experts viewed that there was theoretical validity used in designing framework which consisted of 1) context base, 2) psychological and pedagogies base, and 3) technological and media theory base. Each learning innovation components was designed based on theories and found the consistency between theories and designs obviously and completely.

Fig. 3 . The element of learning innovation to enhance knowledge construction and scientific thinking for students in basic education

DISCUSSION AND CONCLUSION

The synthesis of learning innovation framework to enrich knowledge construction and scientific thinking for pupils in basic education were the theoretical framework consist of three foundation bases as the following; 1) context base, 2) psychological and pedagogies base, and 3) technological and media theory base. The designing framework consisted of four foundation bases as the following; 1) to activate the cognitive structure innovation, enhancement knowledge construction, and scientific thinking; 2) to support an adjustment of conflict cognitive innovation and enhance knowledge construction and scientific thinking; 3) to provide the cognitive structure and innovation to enhance knowledge construction and scientific thinking; and 4) to assist the enlargement knowledge construction and scientific thinking. The foundation bases consist of seven essential elements as following; 1) case study center, 2) resource center, 3) scaffolding center, 4) related case center, 5) lab center, 6) knowledge sharing, and 7) consult center. This framework was reviewed and evaluated by experts which assume that effective and implementable on knowledge construction and scientific thinking. The research findings consistent with the study of [18], [19] which studied on the framework for development of cognitive innovation to enhance knowledge construction and memory process, the study of [20] about the designing framework of multimedia learning environment to enhance problem solving transfer, and the research of [21] who conducted on the scientific thinking of the learner's learning with knowledge construction model enhancing scientific thinking. This study was different to the above studies in terms of focusing on the design and development of learning innovation to enhance knowledge construction and scientific thinking for students in basic education based on theoretical framework components as 1) context base, 2) psychological and pedagogies base, and 3) technological and media theory base. Furthermore, it was found that this learning innovation was developed and examined the designing quality by the expert in all three subjects as content, multimedia, and designing.

Acknowledgement

This research was granted from the research and development institute, Nakhon Phanom University and Faculty of Education, Nakhon Phanom University.

REFERENCES

[1] National Education Act (1999). *Education, vocational guidance and training, Thailand* [Online]. Available: https://goo.gl/18j41R

[2] Labour Protection Act (no. 4). (2010). *Occupational safety and health* [Online]. Available: https://goo.gl/8ZbV1B

[3] H. Alghamdi and L. Sun, "Business and IT alignment in higher education sector," *International Journal of Technology and Engineering Studies,* vol. 3, no. 1, pp. 01-08, 2017.

[4] T. S. Kuhn, *The structure of scientific revolutions.* Chicago, IL: University of Chicago Press, 1962.

[5] H. Alghamdi and L. Sun, "Business and IT alignment in higher education sector," *International Journal of Technology and Engineering Studies,* vol. 3, no. 1, pp. 01-08, 2017.

[6] S. Saowakon and C. Sumalee, "Development of rich chemistry multimedia learning environment models to foster scientific thinking," *European Journal of Social Sciences,* vol. 30, no. 3, pp. 410-412, 2012.

[7] Z. A. Mohideen, K. Kaur, S. Muhamad, N. A. W. Jan and A. B. Ahamadhu, "ITIL: Implementation and service management best practices in Malaysian academic libraries," *International Journal of Technology and Engineering Studies,* vol. 3, no. 2, pp. 65-73, 2017.

[8] The Basic Education Core Curriculum. (2008). *Science learning areas* [Online]. Available: https://goo.gl/2cTKdP

[9] R. N. Tarmuchi, H. Mohamed and A. S. Ismail, A" synchronous learning tools use in graduate study: A preliminary survey," *International Journal of Humanities, Arts and Social Sciences,* vol. 1, no. 1, pp. 13-18, 2015.

[10] R. E. Mayer, "Learning strategies for making sense out of expository text: The SOI model for guiding three cognitive processes in knowledge construction," *Educational Psychology Review,* vol. 8, no. 4, pp. 357-371, 1996.

[11] A. Collins, J. S. Brown and A. Holum, "Cognitive apprenticeship: Making thinking visible," *Journal of the American Federation of Teachers,* vol. 15, no. 3, pp. 6-11, 1991.

[12] J. Piaget, *The moral judgment of the child.* New York, NY: Free Press, 1965.

[13] L. S. Vygotsky, *The psychology of art.* Cambridge, MA: MIT Press, 1971.

[14] R. D. Hannafin, "Achievement differences in structured versus unstructured instructional geometry programs," *Educational Technology Research and Development,* vol. 52, no. 1, pp. 19-32, 2004.

[15] D. H. Jonassen, "Thinking technology: Towards a constructivist design model," *Educational Technology,* vol. 34, no. 4, 34-37, 1994.

[16] D. Kuhn, "What is scientific thinking and how does it develop?" in *Handbook of childhood cognitive development (Blackwell)*, U. Goswami, Ed. New York, NY: Teachers College Columbia University, 2010.

[17] L. S. Vygotsky, "Principles of social education for the deaf-mute child," in *The collected works of cognition and language (A Series in Psycholinguistics),* R. W. Rieber and A. S. Carton Eds. Boston, MA: Springer, 1993.

[18] L. S. Vygotsky, *Thought and language.* Cambridge, MA: MIT Press, 1962.

[19] K. Parama, C. Sumalee, S. Charuni and K. Issara, "Framework for development of cognitive innovation to enhance knowledge construction and memory process," *Social and Behavioral Sciences,* vol. 46, pp. 3409-3414, 2012.

[20] K. O. Nuttariya, C. Sumalee, K. Issara and S. Charuni, "Designing framework of multimedia learning environment to enhance problem solving transfer," *Social and Behavioral Sciences,* vol. 46, pp. 3421-3425, 2012.

[21] G. Thitima and C. Sumalee, Scientific thinking of the learners learning with the knowledge construction model enhancing scientific thinking, *Social and Behavioral Sciences,* vol. 46, pp. 3771-3775, 2012.

— This article does not have any appendix. —