Designing Framework of Augmented Reality Learning Environment to Promote Analytical Thinking for Grade 8 Student

Preeyanan OAKKARAWONG[a] & Charuni SAMAT [b*]
[a]*Educational Technology, Faculty of Education, Khon Kaen University, Thailand*
[b]*Computer Education, Faculty of Education, Khon Kaen University, Thailand*
*thaibannok@hotmail.com

Abstract: Analytical thinking involves the process of gathering relevant information and identifying key issues related to this information. This type of thinking ability also requires you to compare sets of data from different sources; identify possible cause and effect patterns, and draw appropriate conclusions from these datasets in order to arrive at appropriate solutions. Moreover, the purpose of this research was to design of constructivist augment reality learning environment to promote analytical thinking. The expert reviews for assessment of the efficiency of constructivist augment reality learning environment were as follows: three content experts, two instructional designers, two augment reality learning designers, and one measurement and evaluation expert. The research design are used the document analysis and survey. The procedure were as following: 1) to examine and analyze the principles and theories regarding constructivist augment reality learning, constructivist and analytical thinking 2) to synthesize designing framework of augment reality learning environment to promote the analytical thinking 3) to design of augment reality learning environment to promote the analytical thinking, and 4) to evaluate the efficiency of the constructivist augment reality learning environment to promote the analytical thinking. The result revealed that: 1) The constructivist augment reality learning environment to promote the analytical thinking was comprised of six components are following: (1) Problem base and learning tasks to promote analytical thinking (2) Resources (3) The center of promote analytical thinking (4) Collaboration (5) Scaffolding and cognitive strategies for problem solving, and (6) Coaching center by experts. 2) The efficiency of the constructivist augment reality learning environment to promote analytical thinking are shown in following: learning content, instructional design and the augment reality learning design.

Keywords: Analytical thinking, Augmented Reality, Constructivist learning environment

1. Introduction

Learning in the 21st century, both of instructors and the learners can learn together. In the present, the roles of the teachers and students have been changed. The students can learn outside the classroom they can exchange and construct their knowledge by themselves around their environment and including they can bring technology use for their learning.

The analytical thinking is the person who has a letter of analytical thinking more they the others about the development of intelligence, the deeply of analytical thinking must to use the abilities of observe, searching and how to identify for the reasons. Also, when the person can link about the interpret to the understanding it's might be get a fact of the knowledge for solve the problems including the assessments and the decision for everything correctly (Chaijaroen, 2009).

Constructivism is basically theory based on observation and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge. To do this, we must ask questions, explore, and assess what we know. In the classroom, the constructivist view of learning can point towards a number of different teaching practices. In the most general sense, it usually means encouraging students to use active techniques (experiments, real-world problem solving) to create more knowledge and then to reflect on and talk about what they

are doing and how their understanding is changing. The teacher makes sure she understands the students' preexisting conceptions, and guides the activity to address them and then build on them.

Augmented Reality (or AR in short) is both a variation and the opposite of virtual reality. It allows users to see the real world around them with virtual objects superimposed on that physical environment. Augmented reality supplements reality rather than replaces it. The AR system has the following characteristics (Azuma): 1) Combines the real and virtual, 2) Is interactive in real time, 3) Operated in and with a three dimensional environment. This study focuses on augmented realities (AR) for learning that utilize mobile, context-aware technologies (e.g., smartphones, tablets), which enable participants to interact with digital information embedded within the learning environment.

The reasons mentioned above, this study recognize the importance of computer classroom learning environment design. The researcher applied the analytical thinking, constructivist theory and the augment reality attribution and symbols system used, synthesizing them as the framework for designing the constructivist augment reality learning environment to promote analytical thinking. The finding may help to promote the analytical thinking and knowledge construction to the students.

2. The Purposes of This Study

This study aimed to design of constructivist augment reality learning environment to promote analytical thinking.

3. Augmented Reality Learning Environment

Augmented reality learning environment is a media that design based on theory to practice; coordination between the method: cognitive constructivist, social constructivist theory, cognitive theory, analytical thinking and the media and technology: media symbol system, media attribute as hyper text, hyper link, hyper media, and technology for learning (AR-technology). Augmented reality learning environment with an emphasis on the affordances and limitations associated with AR as it relates to teaching, learning, and instructional design. As a cognitive tool and pedagogical approach, AR is primarily aligned with constructivist learning theory and analytical thinking, as it positions the learner within a real-world physical and social context while guiding, scaffolding and facilitating participatory and metacognitive learning processes such as authentic inquiry, active observation, peer coaching, reciprocal teaching and legitimate peripheral participation with multiple modes of representation.

4. Methodology

This study developed the constructivist augmented reality learning environment to promote analytical thinking. The research methodology is Developmental Research in Type I (Richey and Klein, 2007) consists of three processes, the first is product design, the second is product development, and the third is product evaluation. This research is in the first and second process as about product design and development. In this research will be presented the research results in the design and development process, which is the details of document analysis method research design, the synthesis of theory concept, and the synthesis of constructivist learning environment design concept through augment reality to promote the analytical thinking.

4.1 The Target Groups

The expert reviews for assessment the efficiency of constructivist augment reality learning environment were as follows: three content experts, two instructional designers, two augment reality learning designers, and one measurement and evaluation expert.

4.2 Research Design

This research methodology was documentary research and survey research comprised of 1) the synthesis of theory concept, 2) the synthesis of the constructivist learning environment design concept through augment reality to promote the analytical thinking, 3) development of the constructivist augment reality learning environment, and 4) evaluation of the learning environment.

4.3 Research Instrument

The instruments in this study consisted of experimental instruments: the constructivist augment reality learning environment to promote analytical thinking and data collection instruments. Both are described below. 1) The instrument for experiment included the constructivist augment reality learning environment to promote analytical thinking. The process of the design was as follows: (1) to examine the principles and theories, (2) to synthesize designing framework of the constructivist augment reality learning environment, (3) to design the constructivist augment reality learning environment based on above mentioned designing framework, and (4) to evaluate the efficiency of the constructivist augment reality learning environment. 2) The instruments for data collecting including: (1) the record form of document analysis, and (2) the evaluation form for the experts.

4.4 Data Collecting and Analysis

The researchers collected the data as follows: 1) Synthesis of theoretical framework and Components of the learning environment. The data were collected by analyzing principles, theories, related research of the constructivism theory, cognitive theory, media and technology theory, pedagogy and contextual study. 2) Synthesis of Designing framework of the learning environment: The above synthesized theoretical framework was taken into this process. The underlined theories base such as, context of school base, constructivist base, pedagogical base, analytical thinking base, and technology and media base (AR technology and media symbol system) for the synthesis of the theoretical framework of the learning environment. 3) Design and develop of the learning environment based on foundation of creating designing framework was adopted. 4) Evaluate of the learning environment by experts. The analytical description, summarization and interpretation were used to analyze data.

5. Research Results

The design and development of the learning environment that promote students' analytical thinking are follows:

5.1 The Components of the Learning Environment Model

5.1.1 Synthesis of Theoretical Framework

The results show that the theoretical framework of web-based learning environment comprised of five basic theories: (1) Context of school base are follows: Policies, Targets, Present situation, Processes, and Performances, (2) Constructivist base are follows: Constructivist cognitive (Piaget, 1992) and social constructivist (Vygotsky, 1962) theory and cognitivism; and Information processing theory (Klausmeier,1985), (3) Pedagogical base are follows: OLEs Model (Hannifin,1999), SOI Model (Mayer,1996), Situated learning (Brown, Collins and Dugoid, 1989), Cognitive apprenticeship (Brown and Collins, 1991), (4) Analytical thinking base are follows: Identify the elements, Identify the relationships reason, Classification of things (Sumalee et al., 2008) (5) Media theory and technology base are follows: Web-based learning, Augmented Reality (Donald, 2014) and the system of media. Figure 1 showed the relationship between the underlined basic theories components of the theoretical framework for augmented reality learning environment to promote analytical thinking on topic implementation of computer software for grade 8 student.
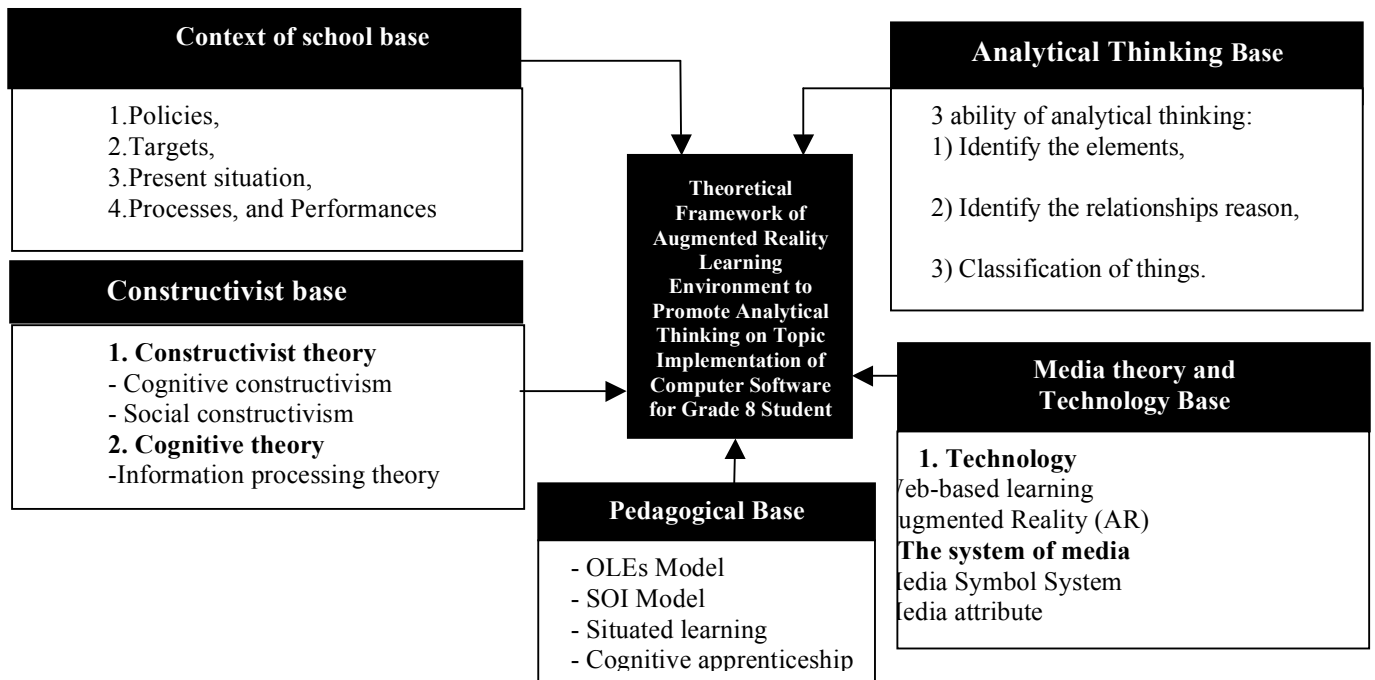
Figure 1. Theoretical Framework for Augmented Reality Learning Environment to Promote
Analytical Thinking on Topic Implementation of Computer Software for Grade 8 Student

5.1.2 Synthesis of Designing framework

According to this study, the findings of synthesis of the theoretical framework which was used as foundation in synthesizing the designing framework of the learning environments to for promote analytical thinking and augmented reality found that 4 crucial bases follows. The findings from the study could be utilized as the basis for synthesizing the designing framework in the design of the learning environment model as follows:

5.1.2.1 Activating cognitive Structure, Analytical Thinking

Activating cognitive Structure, analytical thinking, it illustrated the relationship between the underlined theories and the component as follows: cognitive constructivism (Piaget, 1985); cognitive conflict, situated learning (Brown, Collins and Duguid, 1989); authentic context, OLEs (Hannafin, 1999); enabling context, analytical thinking (Sumalee et al., 2008) as follows of 3 ability: Identify the elements, Identify the relationships reason, and Classification of things. The composition of the problem base and learning task to promote analytical thinking. This may help activating cognitive structure of the students. Figure 2 showed theoretical framework designing problem base.
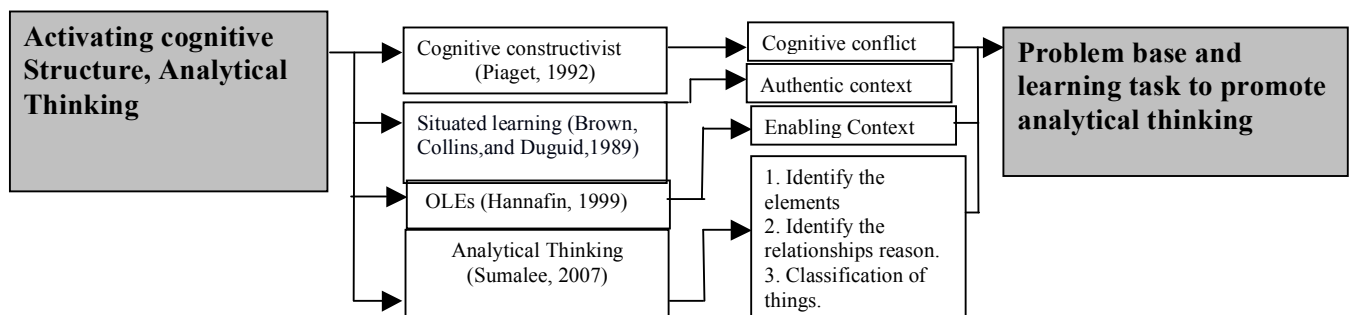

Figure 2. Theoretical Framework Designing Problem Base

5.1.2.2 Supporting Cognitive Equilibrium

Supporting cognitive equilibrium. It was illustrated the relationship between the underlined theories and the component as follows: information processing theory (Klausmeier, 1985); sensory register, short-term memory, long-term memory, analytical thinking (Sumalee et al, 2008); conceptual model, SOI model (Mayer, 1996); selection, organizing, integrating designing of the component of which was called Resources. It focused on how the students process the information effectively. This can help the students understand easily. Figure 3 showed theoretical framework designing resources.
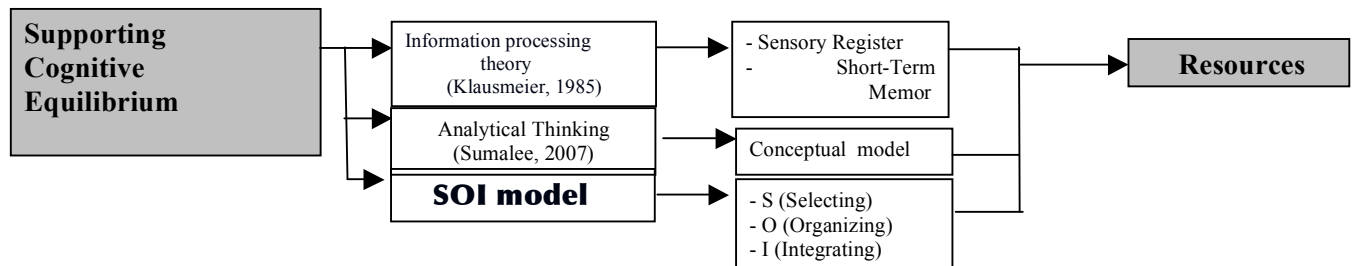
Figure 3. Theoretical Framework Designing Resources

5.1.2.3 Enhancing Knowledge Construction Analytical Thinking and Augmented Reality

Enhancing knowledge construction analytical thinking and augmented reality, it illustrated the relationship between the underlined theories and the components as follows theory: Analytical thinking (Sumalee et al., 2008) as follows of 3 ability: Identify the elements, Identify the relationships reason, and Classification of things. The composition of the Analytical thinking center; Social constructivism (Vygotsky, 1962); The composition of the Collaboration – which supports learners to share experiences, widen their perspectives, contemplate, and modify and prevent wrong understanding. The relationship between the underlined theories and components of the learning environment was shown in Figure 4.
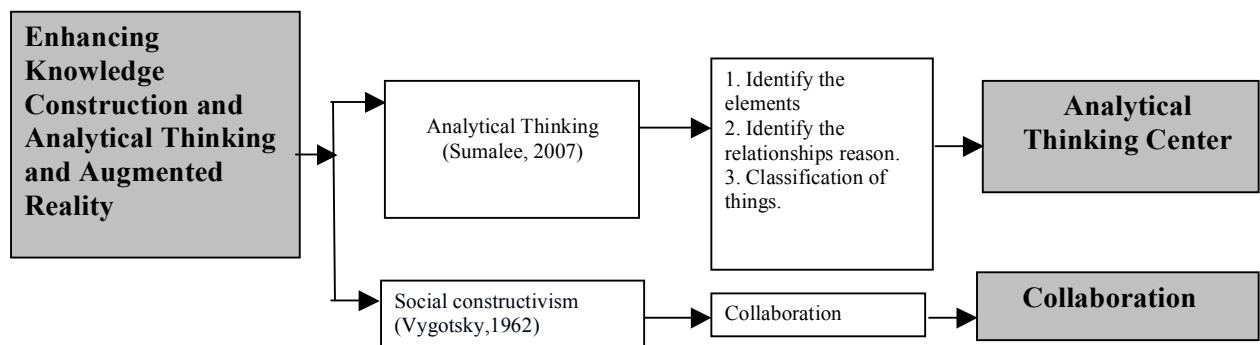

Figure 4. Theoretical Framework Analytical Thinking Center and Collaboration

5.1.2.4 Supporting and Enhancement for Constructing Knowledge

Supporting and enhancement for constructing knowledge, it illustrated the relationship between the underlined theories and the components, as follows: social constructivism (Vygotsky, 1962); zone of proximal development, OLEs (Hannifin, 1999); Scaffolding, The design of the component was called Scaffolding; CLEs (Jonassen and Henning, 1999); Coaching, The design of the component was called Coaching. The relationship between the underlined theories and components of the learning environment was shown in Figure 5.
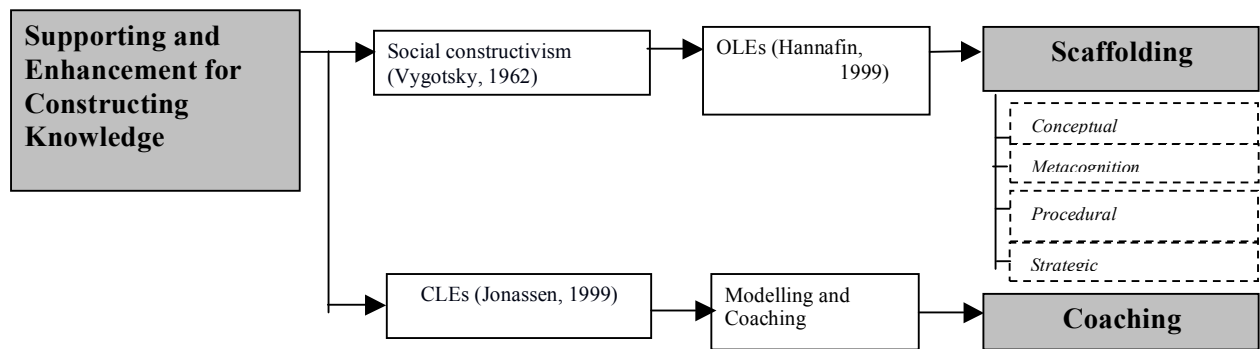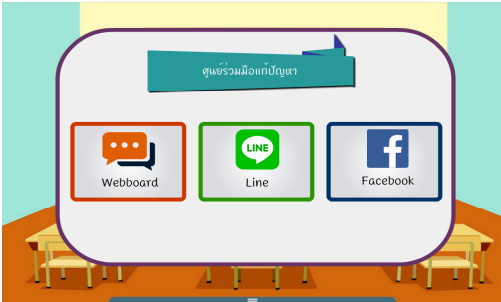
Figure 5. Theoretical Framework Designing Scaffolding and Coaching

5.2 The Constructivist Augmented Reality Learning Environment to Promote Analytical Thinking

Constructivist augmented reality learning environment to promote analytical thinking designing framework comprised of 6 components as follows: (1) Problem base and learning tasks to promote analytical thinking (2) Resources (3) The analytical thinking center (4) Collaboration (5) Scaffolding, and (6) Coaching center. An example of the constructivist augment reality learning environment to promote analytical thinking was showed in Table1.

Table 1: Components of constructivist augmented reality learning environment

Element	Describe the elements	Example of design Shot
(1) Problem base	Problem base: It was shown Problem base for enhancing the learners to construct knowledge and analytical thinking.	Problem base and learning task to promote analytical thinking
(2) Resources	Resources: It was shown Resources to provide just-in-time information to help learners comprehend and solve the problem.	Resources

Element	Describe the elements	Example of design Shot
(3) Analytical thinking center	Analytical thinking center: It was shown Analytical thinking center for enhancing analytical thinking. (Sumalee et al., 2008).	Analytical thinking center
(4) Collaboration	Collaboration: It was shown Collaboration for supporting the learners to share their experience with experts.	Collaboration
(5) Scaffolding	Scaffolding: It was shown Scaffolding for enhancing students to solve problems, to learn and construct the knowledge by themselves.	Scaffolding
(6) Coaching center	Coaching center: It was shown Coaching center by teachers and experts in analytical thinking.	Coaching center

5.3 The Results of the Efficiency of the Constructivist Augment Reality Learning Environment to Promote Analytical Thinking

The results of an expert on learning content, instructional design and the augment reality learning design, a way to check the quality of the specialists (Expert reviewer) Content Design and augment reality environment to learn from the evaluate form. The learning environment is designed according

to the principles of the theory as a basis for the design. Overall fitness and help promote the creation of knowledge-based theory constructivist Whistler undertakings augment reality is a new technology that promotes analytical thinking as well. The assessment the assessment of the experts on the learning content, instructional design and the augment reality learning design, detailed as shown in Table 2.

Table 2: The result of the efficiency of the constructivist augment reality learning environment to promote analytical thinking

No	List assessment	Experts' opinions
		percent
learning content		
1	Appropriate learning content.	80
The design elements of the learning environment.		
2	Problem base	80
3	Resources	70
4	Analytical thinking center	80
5	Collaboration	80
6	Scaffolding	80
7	Coaching center	80
Comments about augment reality learning design		
8	Augment reality learning design promotes analytical thinking	70
	Total	77.5

According to Table 2, the results of the assessment of the experts on the learning content, instructional design and the augment reality learning design. Learning Environment found that the learning content, instructional design and the augment reality learning design. The synthesized; Consistent design principles along constructivist Whistler augment reality that promotes analytical thinking was 77.5 percent.

6. Conclusions and Future developments

This study designed the augmented reality learning environment to promote analytical thinking. The finding of this study show that both of theoretical framework and designing framework of the augment learning environment to promote analytical thinking. However, to enhance students' analytical thinking ability, we are going to study about the effect of augmented reality learning environment to promote analytical thinking learning with mobile technology on students' analytical thinking.

Acknowledgements

References

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, 18(1), 32–43.

Chaijaroen, S. (2009). *Education Technology: Principles, Theories, and Implementation*. Khon Kaen: Khlung Nanawittaya.

Donald, D. M. (2014). *Augmented Reality on Mobile Devices to Improve the Academic Achievement and Independence of Students with Disabilities*. Doctoral Dissertations, University of Tennessee, Knoxville.

Hannafin M. (1999). *Open Learning Environments: Foundation, Method, and Models*.New Jersey: In Charles.

Jonasen, D.H. and Henning P. (1999). Mental Model: Knowledge in the head and knowledge in the world. *Education Technology*, 39(3); 37-42.

Klausmeier, H.J. (1985). *Educational psychology*. New York, Harper & Row.

Mayer, R.E. (1996). Designing Instruction for Constructivist Learning. *Instructional Design Theories and Models: A New Paradigm of Instructional Theory. Volume II*. Newjersy: Lawrence Erlbaum Associates.

Piaget, J, (1992). *Judgment and reasoning in the child*. Translated by Marjorie Warden. London: Routledge & Kegan Paul.

Richey, R. C., Klein, J. (2007). *Design and Developmental Research*. New Jersey: Lawrence Erlbaum Associates.

Sumalee, C., Issara, K., Suchat, W., & Charuni, S. (2008). The Learner's Conceptual Thinking Learning with Learning Innovation Encourage Human Thinking. *Journal of Cognitive Technology*. 3(2); 48-55.

Vygotsky, L. (1962).*Thinking and Speaking*. Cambridge, MA: MIT Press.