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Thinking on Computational Thinking for
Secondary Schools

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DEVELOPMENT OF WEB-BASED LEARNING WITH AUGMENTED REALITY (AR) TO PROMOTE ANALYTICAL THINKING ON COMPUTATIONAL THINKING FOR SECONDARY SCHOOLS

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Abstract. The objectives of this research were 1) to development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools. 2) to study the analytical thinking of the students who learned through development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools. These aims were used for students in grade 4 The target for this study were 35 students in grade 4/2 who studying in the subject of Wor31181 Technology (Computational Science) in the first semester in 2021 at Khon Kaen University Demonstration School, Secondary Department. (Education) The tools which used for data collection consisted of 1) an analytical thinking measure, 2) an achievement test and 3) a satisfaction questionnaire. The results of research found that; 1. The result of students who study the development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools, Secondary Department. (Education) There are 6 important elements in creating and development, namely 1) problem situations, 2) learning resources, 3) exchanging knowledge, 4) analytical thinking center, 5) supporting base and 6) advice center. 2. The result of students who study the development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools, Secondary Department. (Education) The mean score was 29.57, representing 84.49%, which was higher than the specified threshold of 70% of the full score, divided into different aspects of the analysis as follows: The analysis had an average score of 6.00 or 100%, the relationship analysis had an average score of 8.00 and an average of 100%, and the principle analysis had an average score of 15.43, representing 96.44%.

Keywords: Analytical thinking, Learning environment, Web-based learning, Augmented Reality

1 Introduction

At present, the world has new changing in the era of globalization which is driven by the rapid progress due to the advances in information technology and communication affects the awakening of the revolution in terms of society, culture, economy, politics, science, technology and including reform and change in teaching and learning management as well as preparing in various fields that are supporting factors that will lead to learning the advancement of technology that has made information and knowledge which constitutes “information” that can flow easily and quickly until it can be applied widely. Since the outbreak of the coronavirus 19 has greatly affected teaching and learning. Online teaching is therefore being used instead of traditional teaching and learning and tend to use online tutoring more and longer. Information technology is therefore an important variable that plays a role in teaching and learning to make teaching and learning more effective. (Theeradej Bunnapha et al., 2015)

An important method that can develop learners to have characteristics that respond to change in society. As mentioned above is the application of augmented reality technology which is a technology that combines the real world into the virtual world through a webcam device, mobile phone camera or computer with using of various software that will make the image seen on the screen to be objects such as people, animals, things in a 3D which has a 360-degree view. [1]

Teaching and learning about computational concepts as part of the basic science and technology (computational science) course for grade 4, Technology, Science learning subject group according to the Basic Education Core Curriculum of the Year 2008. The content of this unit is to study about computational concept which is a course with content that is quite difficult, complex, and has an abstract nature. The original teaching method was based on a lecture-based teaching method, view pictures from the book and no joint activities then affect the students not understanding the content and having poor academic achievement and lack of thinking skills. [1] [2]

The researchers are interested in conducting research on “development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools” to help learners see clearly in the form of a three-dimensional model such reasons above which can understand the body of knowledge more easily. Bringing lessons on the network with augmented reality technology to support analytical thinking on computational concepts for students in grade 4 as a teaching material to increase the interest in learning, resulting in reinforcement to encourage analytical thinking, having good learning development for learners in order to use the results of this research as a guideline to promote and continue to support effective learning management. [2] [3] [4]

2 Research objectives

2.1 To develop of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools.

2.2 To study the analytical thinking of learners who learned through development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools.

3 Research scope

This research is development research (Richey and Klein, 2007), which focuses on the design and development process. Its purpose is to design and develop augmented reality (AR) web-based learning to promote critical thinking, computational thinking for secondary schools. which in this design and development process consists of document research a study of the teaching context and learning management Synthesis of design concepts and improve quality. [5] [6]

4 Research method

Development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools. in this research study. Based on the development by applying the concept of Richey & Klein (2007) which consists of 3 process;

1. Design Process
2. Development Process
3. Evaluation Process

4.1 Target group

The target group used in this study were grade 4/2 students studying in the course for 31181 Technology (Computational Science) in the first semester of the academic year 2021 at Khon Kaen University Demonstration School, Secondary (Education) for 35 students.

4.2 Researching tools

1. Development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools.
2. Analytical Thinking measurement, built on the framework of Suwit Munkham (2005)

4.3 Collecting data

1. Conduct document analysis (Document analysis) by conducting studies and analyze the principles, theories about the design of the learning environment model, consisting of the following fundamentals: Psychological base, Pedagogies base, Problem solving thinking, Media, Technologies base and Contextual base to be used as the basis

for synthesizing the theoretical framework for the development of learning environment on the network.

2. Theoretical framework creates a conceptual framework based on study and analysis of theoretical principles, research, variables, linking the relationship between theoretical principles and this research study was based on the principle of relevant research and theories can be synthesized from the theoretical framework from the basic theory is as follows. Fundamentals of Analytical Thinking (Suwit Munkham, 2005) Fundamentals of Learning Psychology (Cognitive constructivist, Social constructivist, Information processing), Fundamentals of Media Theory (Media Symbol System), Fundamentals of Technology (Web base technology, Interactive), Fundamentals of Pedagogical Sciences. Constructivist learning environment, Cognitive Apprenticeship and Contextual basis.

3. Study the context of teaching and learning in the course of Wor31181 Technology (Computational Science), which consists of content analysis. The subjects used in the research were on the topic of problem solving and the study of learner contexts, results of the study, contexts related to teaching and learning in the course of Wor31181 Technology (Computational Science). [7]

4. Synthesis of the design framework from the results of theoretical conceptual framework studies and context studies It can be used as a basis to synthesize a conceptual framework for web-based learning design, which will be the component of a web-based learning model. [7] Then use it to develop knowledge on the network and assess the effectiveness of web-based learning by bringing the web learning model to present to a consultant for review.

5. Bring the web-based learning on the network that have been evaluated by experts to be tested in real context.

4.4 Data analysis and statistics used

1. Checking the quality of the format by experts in content, media, and measurement and evaluation. Data analysis was performed using interpretive summaries.

2. The student's Analytical Thinking obtained from the student's Analytical Thinking measure. Data were analyzed using statistics such as percentage, mean and standard deviation.

5 The result of research

1. Creating a theoretical conceptual framework, a conceptual framework based on the study and analysis of theoretical principles, research, variables and linking relationships between theoretical principles. Research and related theories are able to synthesize the conceptual framework as follows.

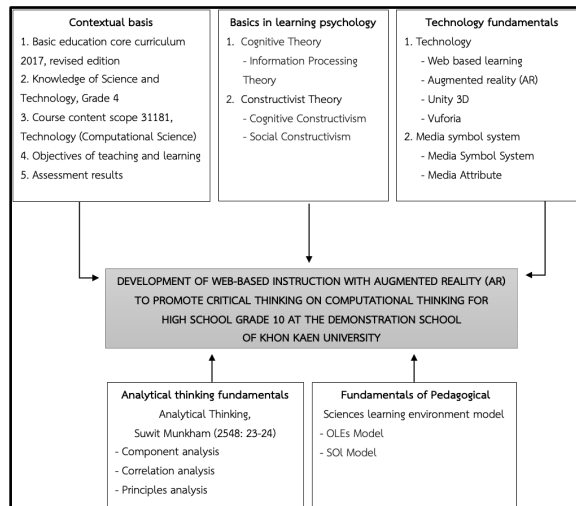


Figure 1: Theoretical framework of the development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools.

2. Synthesize a design conceptual framework.

This step is to synthesize the conceptual framework for developing networked lessons with augmented reality technology to promote analytical thinking on computational concepts [8] [9]. The researcher has applied the theoretical framework as a guideline for the synthesis as a design conceptual framework based on theoretical principles which shows the details of the design conceptual framework in figure 2.

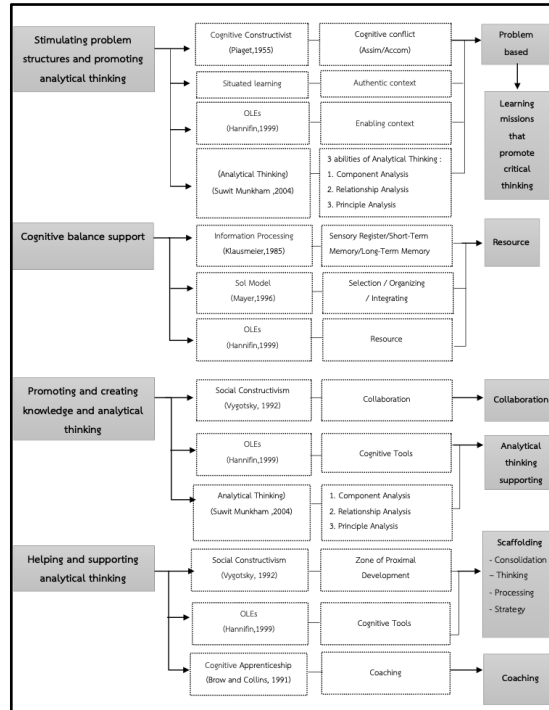


Figure 2: Designing framework of development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools.

The researcher has brought a conceptual framework for developing lessons on the network with augmented reality technology that promotes analytical thinking on computational concepts (Figure 2), elements of networked lessons were designed with augmented reality technology that promotes analytical thinking about computational concepts. There are 6 components which are 1) Problem based 2) Resource 3) Collaboration 4) Analytical thinking supporting room 5) scaffolding 6) coaching, each of them has details as follows.

(1) Problem based is designed to stimulate cognitive structures for learners to create knowledge in designing problem situations in this research. The principles of intellectual constructivism were introduced (Piaget, 1955) and taken as a basis with the principles of Situated Learning to design environment, it is used to design problem situations that are designed in authentic contexts learn to face in real life because it will help learners to link their knowledge to problem solving.

(2) Resources are sources of information content that students need to use in a problem situation and also a source that includes things that students need to search and find answers which learning resources may be in the form of learning resources involved in creating knowledge which the researcher has carried out in the development process based on the technology and the symbolic system of the media. It is the unique

features of technology and media symbol system in the process of developing learning resources which can display text, audio, still images, animations, videos and virtual reality technologies leading to learn that promotes learners' learning.

(3) Collaboration is based on Lev Vykotsky's theory of social constructivism, which emphasizes social interaction in learning. It is another element that supports learners to share experiences with others to expand their perspectives, collaborative problem-solving encourages learners, teachers, and experts to discuss, express your opinions with others for designing collaborative solutions while creating knowledge. In addition, collaborating to solve problems is also an important part of change and prevent misunderstandings that will occur while learning as well as expanding the concept by using Facebook and Line as ways between learners and teachers for using in contacting questions or suggesting solutions to solve problems.

(4) Analytical Thinking Promotion Room is to promoting knowledge and analytical thinking through intellectual balance. Based on OLEs principles, the researcher has designed and developed to help supporting the learning process and the students' critical thinking as an intermediary to support, enhance or expand their thinking. Collaborative problem-solving is based on Lev Vykotsky's theory of social constructivism which emphasizes social interaction in learning. It is another element that supports learners to share experiences with others. In addition, collaborative problem-solving is also an important part of modifying and preventing misunderstandings that occur while learning and expanding ideas as well as the development of a room to promote analytical thinking to help encourage students' critical thinking that consists of component analysis, correlation analysis principle analysis., Suwit Munkham (2005)

(5) Scaffolding is a supportive part of helping thinking that supports an individual's thought process. It guides the way of thinking between learning the thinking methods used to solve the problems under which to study and the possible strategies that should be considered helping [10]. A process that recommends how to use it and resources and tools, strategic assistance that will assist learners in supporting their thinking analysis in which students consider how they can be applied to problem-solving situations and conceptual assistance that allows them to conceptualize the subject matter of the unit.

(6) Coaching is based on the principles of the Cognitive Apprenticeship Model (Brown & Colling, 1989), based on Situated Learning [11] [12]. This principle has become a constructivist approach to learning that has transformed the role of an instructor who transfers knowledge or imparts knowledge to a “coach”, providing advice and guidance for learners as an exercise for learners by educating students in terms of providing intelligence which the researcher has designed and developed on the basis of technology and media symbol system.

6 Summary and Discussion

From the findings of the research in this study show that networked learning with augmented reality technology promotes analytical thinking on computational concepts which is a combination of principles, theories, basic technological features and media symbolism by design based on constructivist theory that focuses on knowledge creation helping to promote the knowledge creation of learners and problem situations promotes analytical thinking of Suwit Munkham (2005), including all elements of networked lessons with augmented reality technology that promotes analytical thinking about computational concepts for students in grade 4 at Khon Kaen University Demonstration School, Secondary Department (Education) that has brought the advantages of open learning environment (OLEs) to the development of learning environment enabling students to study and acquire knowledge as needed unlimited search for information to answer the mission of the problem situation and to support learning management in the 21st century, emphasizing on learning management by using technology to transfer knowledge to learners in order to develop quality learning management and achieve maximum efficiency for all learners which is consistent with the research results of Suwit Munkham (2005).

7 Suggestion

1. Should study development of web-based learning with augmented reality (AR) to promote analytical thinking on computational thinking for secondary schools among learners in other ways by considering that model to be consistent and appropriate to promote analytical thinking of learners.

2. The learning environment should be arranged in accordance with the ability to analytical thinking and solve problems in each area.

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