ETWC

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WORLD CONFERENCE 2016

PROCEEDINGS
VOLUME 2

"Educational Technology to Improve Quality and Access of Education for Prosperous Society"

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PROCEEDINGS
Volume 2

Educational Technology World Conference (ETWC) 2016

Theme:
"Educational Technology to Improve Quality and Access of Education for Prosperous Society"

Editors:

Prof. Atwi Suparman
Prof. Burhanuddin Tola
Prof. Ivan Hanafi
Prof. Karnedi
Dr. Trini Prastati
Dr. Yuli Rahmawati

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"Educational Technology to Improve Quality and Access of Education for Prosperous Society"

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Speech

Chairperson of Organizing Committee ETWC 2016

Prof. Dr. Atwi Suparman

Distinguished Speakers

Distinguished Guests

Ladies and Gentlemen,

Assalamu'alaikum Wr. Wb.

Peace be upon you with Allah's mercy and blessing

May God bless us all. Amen.

May I take this opportunity to welcome you all and to extend a further word of welcome to everyone here. I would like to extend my graditute to Rector of Universitas Negeri Jakarta, Universitas Terbuka, Universitas pendidikan Ganesha, Universitas Mahendradatta and Head of Kopertis Wilayah VIII that have accommodated and organised this first-ever world class conference of educational technology in Indonesia. We once again thank Bapak/Ibu Rektor and also Kepala Kopertis Wilayah VIII for the time, energy, support, assistance and also funding. The committee would also like to thank all sponsors that support ETWC 2016.

The opening day and a few days forward of Educational Technology World Conference 2016 are certainly the moment we have been looking forward to, as preparing this world class academic forum is not something a fairy Godmother could do – waiving the magic wand and turning the poor little girl into a charming beautiful princess. For this, my highest appreciation goes to all committee members, streering and organising committee and also AECT team that have spent their time, energy and thought not only in convening this conference, but more importantly in making this world class conference a momentum in improving the quality of education. I also believe all of us, especially the keynote and plenary speakers, the parallel and round table sharing session presenters here, will do their best in this conference – sharing and discussing their thoughts and ideas for the good of improving the quality of education in our great nation. For these, I thank you all.

Ladies and Gentlemen,

Looking back at the moment this conference was firstly initiated, it all started in a vision. We envisioned a dream of convening a world class academic forum in Indonesia which in the previous years had been predominantly held in the United States coordinated by Association for Educational Communications and Technology (AECT). Three years ago, in 2013, we attended AECT International Convention in Anaheim, California, in 2013 and discussed with AECT officials the possibility of conducting a world conference in Indonesia. The meeting resulted in the possibility of holding ETWC. One year after that, a small group of UNJ chief officials and I attended AECT annual conference in Jacksonville. At that time AECT agreed for UNJ to hold educational technology world conference in Indonesia this year. Not long after that, we gained support from several universities, i.e. Universitas Terbuka, Universitas Pendidikan Ganesha, Universitas Mahendradatta, and Kopertis Wilayah VIII. Therefore we would like to thank them all for the support.

Ladies and Gentlemen,

The committee has received 287 papers. The total number may possible increase untuil the opening day of the conference. Among those 287 papers, 146 papers will be presented at the parallel sessions whilst 141 papers will be presented at the round table sharing sessions. We provided 10 rooms for the parallel sessions and 8 rooms for the round table sharing sessions. The committee has prepared tokens of appreciation for 30 best papers and made a special arrangement with the help of AECT for the opportunity to publish selected best papers in a book published by Springer. The selection process will be conducted by distinguished invited speakers coordinated by Mike Spector as well as the internal reviewers.

Ladies and Gentlemen,

Bali is chosen as a perfect place for us to exchange and discuss our ideas and thoughts not in a restless, strained, rushed condition (like the one we usually have in big cities, such as Jakarta), but more in a “heavenly-relaxed”, but serious way. After all, as many people have said, Bali is the Island of Gods. It is the place where Gods create their heaven on earth. Thus, in this Balinese atmosphere, let us pour our best thoughts and exchange our brilliant ideas for the good of education quality improvement. Have a pleasant fruitful conference.

Thank you.

Bali, 31 July 2016

Prof. Dr. Atwi Suparman

Chairperson of the Organising Committee

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Learning Science through Inquiry and Multimedia in Elementary School

Dek Ngurah Laba Laksana[1,2], I Nyoman Sudana Degeng[3], I Wayan Ardhana[4], I Wayan Dasna[5]

[1]*Program Studi Pendidikan Guru Sekolah Dasar, STKIP Citra Bakti-Flores*

[2,3,4,5]*Program Studi Teknologi Pembelajaran, Pascasarjana Universitas Negeri Malang*

[1,2]*laba.laksana@gmail.com*, [3]*sudana_daniel@yahoo.com*, [4]*w_ardhana@yahoo.com*

[5]*idasna2006@yahoo.co.id*

Abstract

This present study aimed at (1) examining on how to design science learning in elementary level through multimedia integrated inquiry strategy, and (2) providing empirical evidences of the effectiveness of multimedia integrated inquiry strategy in science learning toward students' conceptual achievement. The result on literature review shows that science learning on elementary levels needs to take students' charateristics into account. Psychologically, primary level learners have a high level of curiousity and enthusiatically discovering new knowledge for them. Since science is considered as both product and process, the use of inquiry is necessary. In this respect, a 5E type from guided inquiry strategy is considered as the most suitable one. It covers engaging, exploring, explaining, elaborating, and evaluating. In each phase, the learning process is integrated with the use of multimedia. This integration aims at (1) increasing students curiousity toward science learning; (2) bringing students to real situation by using media such as pictures, video, animation; (3) exploring and explaining abstract concept such as structure of the earth, the solar system, and the phenomena that occur in the universe. The empirical evidence shows that the use of multimedia can support inquiry activities and improve students' achievement.

Keyword: learning science, inquiry, multimedia

INTRODUCTION

Background of the Study

Learning has a close relation to philosophical science in an effort to develop the scientific inquiry in educational technology field, as well as developing strategies to overcome the problems encountered (Cilesiz & Spector, 2014). One of the learning concepts based on the philosophical science is meaningful learning. Meaningful learning is a result of paradigm shift from behaviourism to the constructivism. Meaningful learning is also considered as a reflection of 21st century learning in the context of the demands of learning that can produce human resources who are capable of critical thinking , solving problems , and being useful for the future (Jansen & Merwe , 2015).

The essence of education paradigm shift is to emphasise on meaningful learning in order to improve life skills. In the context of meaningful learning, learning to understand a concept is the foundation to think at a higher level (Llewellyn, 2013). The importance of understanding a concept, especially in science learning has been studied through a number of studies particularly on addressing the issue of misconceptions (Ates, 2005; Calik et al., 2007; Laksana, 2012; 2014; Niaz, 2005; Turkmen, 2006).

Essentially, science has two dimensions, namely science as a product a process. Both product and process encourages the use of the inquiry approach to learn science (Choi et al., 2008; NRC, 2000). The inquiry-based learning is seen as an umbrella for an inductive approach (Prince & Felder, 2007), and it is appropriate to be applied to build students' understanding. Thus, the inquiry learning strategy is appropriate for conceptual conversion which is a form of learning concepts in the view of constructivism. Inquiry approach has been implemented in various studies because it has advantages in the development of conceptual understanding and thinking skills (cognitive strategies) needed to solve a problem (NRC, 2000).

Ideally, the implementation of inquiry approach requires hands-on activities, where learners are actively investigating real phenomena (Levitt, 2002; Sund & Trowbridge, 1975). Hands-on activities cannot be separated from the availability of tools and materials, as well as sufficient time during its preparation. Hands-on activities for beginner science learners also pose a risk, either by accident or poisoning, thus limit the options in these activities. Therefore, considering on alternatives for managing learning, which appears to be the integration of media technology/multimedia in the implementation of educational technology study is significant.

The advance in technology/multimedia-based computer is an opportunity to create learning materials that supports learning activities. These technological advances provide convenience in designing a teaching media to bring a real phenomenon, in the form of video of facts in laboratory, into the classroom. A number of the inquiry process, namely: identification of the problem, hypothesis, experimentation, observation and measurement, classifying the explanation, and concluding can be facilitated by using computer assistance (Bransford, 1990; Chinn & Silver, 2002).

There are some benefits of using computer-based media in inquiry approach, some to mention are (a) experimentation process could be faster; (b) experimental design can be more complex; and (c) focus on the theoretical aspect (Chinn & Silver, 2002). Furthermore, Chinn & Silver (2002) state that by using a computer, the activities and the results of experiments (real or simulated phenomena) can be accurately controlled by the media maker and match with the theoretical concept. In addition, the ease in designing a conceptual visualization, both static and dynamic, brings computer-based media to support the theoretical aspects. It is in line with Bass et al. (2009) who states the best way to primary or secondary school learners to learn science is through experience. However, this is not always practical, cost-effective or safe. Simulating an experience with the computer can be an effective alternative.

The integration of information and communication technology in learning strengthens the learning paradigm in the 21st century (Jansen & Merwe, 2015). Since the technology is rapidly developed, especially in multimedia technology, it is necessary to synergize the use of technology in inquiry learning. Bass et al. (2009) argues that technology, especially multimedia in inquiry learning, strongly supports the inquiry activities such as in exploring initial idea and enforcing learners' curiosity. The integration of multimedia technology in science learning potentially improve students' understanding (Kirna, 2010; So & Kong, 2007; Turkmen, 2006).

REVIEW OF LITERATURE

Learning Science in Elementary School

Fraser-Abder (2011) defines science as: 1) a constant invention to seek for answers from phenomena happened around us, 2) a study of life and nature, 3) a scope of knowledge which is divided into biology, chemistry, physic, etc., 4) a process of gathering data as well as analysing it, 5) a study of the world and how they are adapting and adjusting each other, 6) an experiment, 7) an inquiry process that covers exploring curiosity, solving problems, and

verifying information. Hardy and Fleer (2008) argue there are some aspects which needs to be concerned on the nature of science, namely: (1) science as a board of knowledge, (2) science as a process of investigation, (3) science as a set of values, (4) science as a social institution, (5) science as a way to know the world, (6) science as a result of human construction, and (7) science as a part of daily life.

Further, NRC (2000) states comprehension in conceptual science is the main goal of science. Some studies reveal that elementary students' ability should be driven along the inquiry process, and they will master a new concept when they are able to use their scientific knowledge. Bass et al. (2009) adds that inquiry-based learning is beneficial to reach the three main goals of science learning, namely: conceptual mastery, investigation ability, and scientific knowledge

Inquiry Strategy

Inquiry is known as a learning strategy where learners are demanded to find and use any source of information as well as their ideas to identify a problem, topic, or issues (Kuhlthau et al., 2007). One of the designs of inquiry learning is 5E (Bybee, 2002; Bybee, 2006; Magee & Ryan, 2012). This model utilises five phases: engage, explore, explain, elaborate, and evaluate.

The teaching team in guided inquiry strategy helps learners to develop their scientific competence, knowledge of the subject matter, motivation, reading comprehension, language development, writing ability, cooperative learning, and social skill (Kuhlthau et al., 2007). All of them are significant in the paradigm of lifelong learning in 21st century (Jansen & Merwe, 2015). Kuhlthau et al. (2007) state the benefits of inquiry strategy, namely (1) preparation for lifelong learning; (2) integrated into content areas; (3) transferable information concepts; (4) using a variety of sources; (5) involving student in every stage of the learning, from planning to final product; (6) curriculum connected to the student world; (7) a community of learners working together; (8) student and teachers collaborating; and (9) put emphasis on the process and product.

The steps of conducting 5E are explained as follows. (1) Engagement phase: The teacher digs up students background knowledge and help learners to be involved in an activity that engages their enthusiasm. That activity links what the learners have known and what they are able to do, expressing the previous concept, and setting the learners' goal of learning. (2) Exploration phase: it is a process of allowing learners to express their ideas, conducting scientific process, and thinking skill which may lead them to conceptual changes. Students are also allowed to compare their ideas and identifying their weaknesses or misconception. In addition,

students can manipulate the subject matter to express new ideas, exploring questions, and doing preliminary investigation. (3) Explanation phase: in this step, there are more interaction between teacher and students. This step focuses on leading the learners to a specific topic and involves them directly into process of learning as well as managing their attitude. (4) Elaboration phase: In this step, the teacher gives a challenge to broaden their conceptual understanding. Through experiencing, learners are going to process new information in deeper sense which also may lead them to new knowledge. (5) Evaluation phase: It encourages learners to assess themselves whether or not they achieve their learning goals.

Multimedia

Multimedia learning is any sources of learning, can be words (e.g. text, narration) and pictures (e.g. illustration, chart, diagram, photograph, map, animation, video) used by teachers to support learning (Clark & Mayer, 2003). Multimedia utilises the computer capacity to solves learning problems. As many teaching strategies use computer to be the main tool to support learning, it is considered important to encourage and motivate students, along with the other possibilities. Lee & Owens (2004) convey that computer flexibility has brought many benefits since the teacher can input video, audio, graphic elements, formula, process, roles, and other responsibilities.

Objectives of the Study

This paper aims at (1) investigating the design of science learning in elementary school by utilising inquiry strategy which is integrated with the use of multimedia from conceptual definition (2) presenting empirical evidences regarding the effectiveness of science learning in elementary school by utilising inquiry strategy which is integrated with the use of multimedia toward students comprehension.

METHOD

This paper is a library research where the researcher narrows and sets multimedia based learning in inquiry class. The empirical evidences are presented by literature study and in accordance with related journal articles in regards to the aim of this study.

RESULT AND DISCUSSION

The Design of Science Learning in Elementary School by Using Multimedia Integrated Inquiry Strategy

The learning activity in inquiry strategy which includes: elicitate learners' ideas (before the inquiry process), examining learners' ideas (during the inquiry process), negotiating meaning (after the inquiry process), implementing the new concept in a new situation, and concluding the lesson and making reflection. The components of inquiry process is initiated by a group work (hands-on activities), such as exploring, hypothesizing, gathering data, and expressing alternative explanation based on empirical evidence stated by the learners. The teacher has a role as a facilitator and guiding learners' ideas. Thus, this inquiry strategy has given a big portion toward students' independent learning. This condition is supported by Bransford et al. (2000) who argue that students' experience and their ability to hypothesize play a big role in learning process, while studies on students cognitive reveal that students' prior knowledge influences their information processing ability.

Inquiry learning, as the umbrella of inductive approach is implemented to build conceptual understanding. The core of inquiry, which are questioning and investigating, can dig up students ideas to build their understanding. This strategy includes five phases, namely: engage, explore, explain, elaborate, and evaluate (see Figure 1)

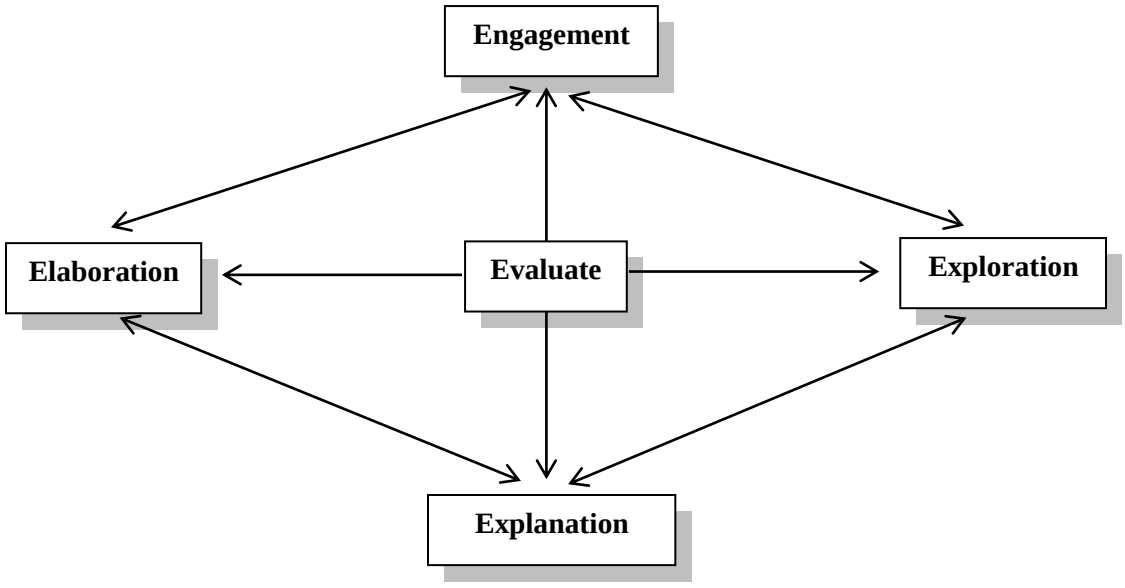

Figure 1. 5E Model (Duran & Duran, 2004)

The inquiry strategy cannot stand itself, but challenging learners to link their world into the topic. During its implementation, inquiry strategy is not only pursuing personal competence, but also increasing the learners' involvement which results in social interaction. Therefore, the learning process is conducted with guidance since the teacher deals with elementary learners (Magee and Ryan, 2012). The design of this strategy is presented in the Figure 2.

Inquiry based learning follows five steps of activities. The engaging phase stresses on enforcing students motivation with the assistance of video and/or information displayed in form of info graphic. It is expected that during a short amount of time, teacher leads learners to the topic discussed.

In the exploring phase, teacher encourages learners to interact each other by administering questions and showing phenomena that can make cognitive conflict. The questions and phenomena are designed on a laptop and being displayed to each learner.

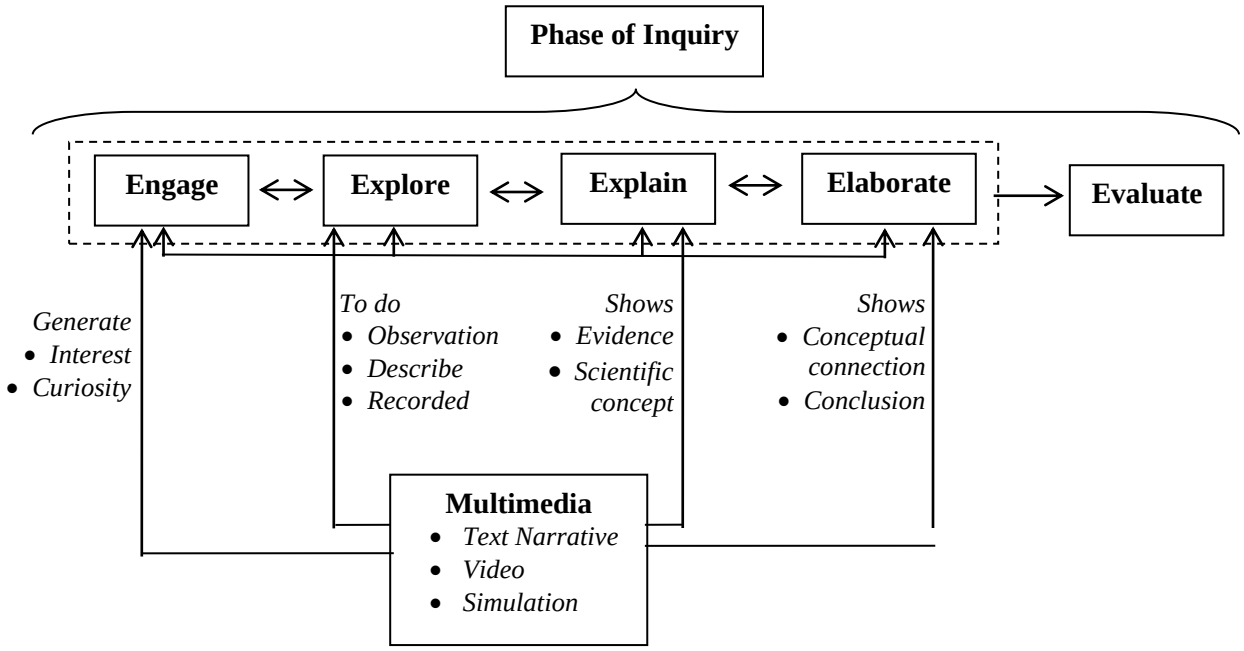

Figure 2. Integrated Mutimedia in Inquiry Strategy

In explaining phase, teacher encourages learners to utilise their daily experience to construct an explanation regarding the questions and phenomena administered by the teacher during the previous phase. In this phase, there is a possibility of misconception that is why introducing terminologies or alternative concepts are explained.

In the elaborating phase, teacher gives reinforcement to the learners by using scientific terms and description. Meanwhile, evaluating phase deals with how teacher observes and assess the students' performance and conceptual understanding. The detail description of the activity is presented as follows.

Table 1. Activities Based on 5E Model in Multimedia Integrated Inquiry Strategy

Stage	5E Model Inquiry with Multimedia	
	Teacher Activity	Students Activity
Engage	• Raising students curiosity and attract their interests by **displaying an infographic model of a topic on multimedia** • Determining students' prior knowledge of a certain concept • Inviting learners to express their thought • Inviting learners to question themselves	• Building their curiosity and interest to a certain topic • Expressing their ideas • Asking questions like "do I know about this? What do I want with this? How do I find it?"
Explore	• Encouraging interaction among learners by grouping them and ask them to explore a topic in **multimedia displays (using tablet, laptop, smartphone)** • Questioning learners to lead them to make arguments • Giving students time to have a cognitive conflict	• Conducting an investigation by observing, describing, and taking notes based on **multimedia** displayed by the teacher • Trying another way to solve a problem • Utilising daily experience to compare between the result of investigation and the initial ideas
Explain	• Encouraging learners to use their daily experience and those that they got during the engage and explore phases to construct an explanation. • Delivering questions that help learners to give explanation • Asking for supporting evidence regarding their explanation • Giving learners time to compare their ideas with other students and revising their work • Introducing some terminologies and giving alternative explanation after the learners express their ideas through multimedia displays	• Explaining a concept using their own language • Giving evidence to support their explanation • Noting the ideas • Stating their ideas in scientific term • Comparing their ideas to the other students.
Elaborate	• Focusing learners attention to the relation between the new concept and their experience • Encouraging learners to use what they have learned during the activity • Giving reinforcement to the learners with the use of scientific terms and description which have been introduced previously (**displayed in infographic mode)** • Asking questions to help learners conclude their ideas based on evidences and data gathered	• Linking the concepts between their new experience and the constructed one • Using what they have learned to explain a new concept, phenomena, structure, or ideas • Explaining in scientific way • Concluding based on evidence and data gathered • Communicating their understanding with others

Stage	5E Model Inquiry with Multimedia	
	Teacher Activity	Students Activity
Evaluate	• Observing and assessing learners understanding, performance, and skills • Interviewing learners regarding the assessment and improvement • Encourage learners to assess themselves	• Demonstrating their understanding in relation to the concepts and how they apply their skill • Comparing their thoughts to other students as well as revise it • Assessing their own learning process and comparing their new understanding to the initial one • Asking questions more deeply about a concept or a topic

Empirical Evidence on the Effectiveness of Multimedia Integrated Inquiry Strategy in Science Learning toward Students Conceptual Outcome

The existence of technology nowadays is used in a number of education and performance related area. New technologies have been introduced before people learn to effectively use the existed one (Spector & Wang, 2002). Spector (2013) have conducted a study that reveal that technology integration in teaching-learning process potentially improve the effectiveness and students outcome. This potential is reflected by the augmented reality based learning and the game based learning as well as multimedia integrated learning.

Reigeluth (1999) adds that the desired outcome is the effect of learning strategy. A learning strategy consists of organising strategy, delivering strategy, and management strategy. In addition, media (including computer based media) is the major component of delivering strategy, therefore media technology is a part of learning process. Media does not effect the learning outcome, but its effectiveness depends on its integration in learning.

The use of multimedia is related to a number of studies which integrate technology and multimedia to a certain learning strategy. Many researchers show the importance of integrating technology to multimedia, and recommend which of them that support inquiry strategy in learning field (Kim et al. 2007). The benefits of integrating multimedia technology to inquiry learning are, (1) to give learners chances to experience scientific model of learning, (2) to involve learners in scientific experiment by simulating and work on scientific data (Chang, Quintana, & Krajcik, 2010; McDonald & Songer, 2008; Wilensky & Reisman, 2006). Generally, integrating multimedia in learning can motivate learners to create an active learning (Muller, Lee, & Sharma, 2008). Some studies also report the strength of using multimedia in learning (Choi et al., 2008; So & Kong, 2007).

Multimedia is defined as an integrated interactive information transfer which covers text, figures, voice, video or animation (Hackbarth, 1996; Philips, 1997; Chapman & Chapman, 2004). Multimedia has strength on the attentive aspect and positive emotional excalation toward learning (Park, & Lim, 2007). Even though some studies show that the use of multimedia is inconsistent, the use of technology in science learning is found positive. The use of technology is prospective to improve science conceptual comprehension, started from elementary schools to the higher one. So & Kong (2008) find that the use of multimedia technology in inquiry learning triggers learners' active learning in primary classrooms.

Wang (2008) conveys that the use of interactive multimedia as an alternative for optometry laboratory experience is as effective as learning in the real laboratory as well as improving their learning outcomes during the first year. This study also shows that virtual application is effective when it is integrated to inquiry based learning.

The aforementioned findings are supported by Kirna (2010) who found that the conceptual science outcome of junior high school students is higher when they use multimedia in inquiry learning than those who do not use it. Besides, it is revealed that visual type learners have a higher conceptual outcome than the verbal type learners. In other words, reaction between learning strategy and learning style has driven to a strength point to conceptual learning.

Piyayodilokchai et al. (2013) describe their finding where group learning with 5E inquiry model is better than group learning which does not use multimedia. The use of 5E model is more effective to reach the conceptual understanding as well as the application.

As a part of science, the findings of previous studies regarding the use of multimedia in science learning is considered significant. There are three ways how to utilise multimedia technology in classroom learning (Kozma & Russell, 2004), namely; (a) as a visualisation tools that can be used by teachers to demonstrate an abstract concept; (b) as a laboratory simulator that can facilitate learners to observe phenomena; and (c) as a feedback in problem solving.

CONCLUSION

The design of science learning in elementary school with multimedia integrated inquiry strategy consists of five steps. The engage phase stresses on how to motivate learners with the assistance of video and information in an info graphic mode. The explore phase put an emphasis on how teacher encourages learners to interact each other by questioning them and showing phenomena until they have a cognitive conflict. The explain phase put an emphasis on using

learners' prior knowledge to construct an explanation regarding the questions and phenomena displayed. The elaborate phase stresses on how teacher gives reinforcement to the learners along with the use of scientific terms as well as the aforementioned description. The evaluate phase emphasises on how teacher observes and assesses students' performance, comprehension, and skills.

The use of multimedia cannot be separated from other studies which integrate technology and multimedia in inquiry strategy. The empirical evidences show that multimedia integrated in science learning can motivate learners and create an active learning.

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