Virtual Field Trips with Inquiry learning and Critical Thinking Process: A Learning Model to Enhance Students’ Science Learning Outcomes

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Abstract

This paper aimed to present a learning model using virtual field trips (VFTs) with inquiry learning and critical thinking process to enhance science learning outcomes of lower secondary students based on the research and development. Phase 1 of this paper showed the process of develop a learning model and phase 2 showed the result of implementation with the lower secondary school students. After implementation, the learning model was revised using qualitative data from observation, students’ opinion from a survey, and the assessment from experts. The research instruments used to assess science learning outcomes were the test for assessing students’ skills of concept mapping, retrieval information, meaningful communication, and critical thinking. Samples were 104 Science teachers, 26 Science education experts, 31 students attending the 8\textsuperscript{th} grade of a secondary school, and 5 instructional design experts. This VFTs learning model with inquiry learning and critical thinking process consisted of five main components: 1) Content and Activities, 2) VFTs media and resources (video clips, pictures, animations, online diaries, worksheets, activity sheets, and games), 3) experts from the field trips resources, 4) a learning management system for virtual field trip, and 5) assessment and evaluation. There were three phases of learning activities: 1) Pre-using the VFT activities (1 week), 2) During the VFT activities (2 weeks), and 3) Post-using the VFT activities (2 weeks). All phases included 6 learning steps: engagement, investigation and exploration, explanation, conclusion, elaboration, and evaluation. The results of exploring effectiveness of the VFTs learning model from one group pretest posttest experimental research design showed the students’ science learning outcomes posttest scores had significantly higher than the pretest at a level of significance of .05 and five experts’ assessment before and after try-out the model were appropriate in high level.

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1. Introduction

When designing learning activities for science teaching, the teachers should foster in their students the desired skills and other related science process. As the science process skills are important foundations and tools in improving skills including thorough thinking, efficiently executing and correctly solving problems. This statement is made in reference to Thailand National Education Act (1999), section 22, which stipulates that the education management needs to be conducted on the principle that all learners have the ability to learn and improve themselves; the learners are the most important; therefore, the education management process must encourage the learners in a natural way to their full potential. The section 23(2) focuses on the education management in formal education, informal education and learner-directed education approaches. It gives the importance to the integration of knowledge, ethics, proper learning process that suites the educational level, especially in science knowledge, science skills as well as technology. It also covers the way to learn, understand, experience the natural resources management, maintenance and maximization in a sustainable balance.

The curriculum design of science and technology subjects puts emphasis on the systematic process that students are the thinkers, executors and learners in various activities; including field activities, observation, review, laboratory experiments, inquiry research from primary and secondary sources, science and technological projects, and learning from local sources. The process will take into account of students’ maturity, previous experience, different environment and cultures before attending the class rooms. The students’ learning occurs when students have direct participations with those educational activities. Then, students will be able to search for knowledge, to solve problems in scientific approach. Students develops themselves to higher order thinking method and with the hope that such learning process can improve their scientific attitude, morale, ethics in using science and technology creatively, proper attitudes and values towards science and technology, as well as enabling them to efficiently communicate and work in collaboration, Good (1973).

In response to such policy, the integration of teaching and learning are then better adjusted to the difference in ability of students, by utilizing information communication technology as a tool to convey the knowledge, and as a mean of communication between teachers and students. Students can learn without time and place limitation; it opens up the opportunity to learn leading to educational equality. With enriched modern technology platforms, students can exchange knowledge communicate across the board rapidly. Students have opportunity in thinking, deciding in learning context, priority knowledge, controlling the learning channels, and presenting their projects. The collaboration between students and teachers; students and students; students and context; as well as students and learning environments create a collaborative exchanging environment. (Bonk and Graham, 2004)

As a result, the integrated technologies can potentially support a quality class room, especially for the activities that have certain limitations, such as the problem that a real filed trip cannot be organized due to limitations of distance, time, security, access, cost and availability of other resources. For these reasons, Cassady and Mullen (2006) and Millan (1995) stated that the virtual field trip is a good alternative for the educational program, which can pass over the difficulties. The teachers and students can experience the virtual field trip any time any way, enriched by modern information and communication technologies. It reduces down many limitations in organizing a real trip, on the contrary, increases the equal opportunity to those students who do not have a chance. Cassady and Mullen (2006) also suggested that the virtual field trip cannot replace real field trip or a real site visit. But the virtual field trip can result in higher learning level, skills and experience than the real field trip. The stimulation for learning during the virtual field trip can be in forms of live broadcast such as web-based broadcast and interactive web, animation and online games(Lacina ,2004).

Bonk and Graham (2006) noted that “The online learning is different from traditional in-classroom learning. The teaching quality does not depend upon the teaching tools and models, but on the intention to achieve the study objectives of students.” In addition, Bersin (2003) also argued that “The mixed teaching models can improve students’ skill in solving problems arising from the activities. Such integrated models are composed of the online and traditional in-classroom activities as well as the teachers’ teaching tactics who facilitate and stimulate the learning by posting questions to students to think and investigate by themselves.” To achieve its maximum learning
level, a virtual field trip needs integrated teaching models to reduce the difference of learners, reduce the time limitation, and to fulfill the limitation of traditional in-classroom teaching. Besides, another important element is the teacher who arouses the interest of students and poses the questions that will stimulate the logical thinking and reasoning ability of students. The most significant objective in science teaching is to transform the students to be enthusiastic, studious and self-directed learners. Referring to Dachakupt (2001), the “process of inquiry teaching” in the science classroom is in accordance with such self-directed learning process.

The process of inquiry teaching is the teaching model which emphasizes the students’ improvement in gathering the knowledge by themselves. Llewellyn (2002) said that “the development in thinking and inquiry teaching process can improve the critical thinking skill. This is because in the inquiry process, when the students receive information, they will think, prioritize the issues and seek the correlation by themselves, before searching for reasons to support and summarize to a new knowledge.” Therefore, the critical thinking is important and supports the inquiry teaching process. The Thai Secretariat of Education (2002) summarized that “everyone can learn from seeing, listening, touching, moving or doing. Therefore, organizing the learning stimulation or activities in various formats; then stimulating the senses of learning and posing questions to arouse the brain to think is one of the inquiry teaching processes.”

Sternberg (1987) who established the intelligence theory proposed that “the ingenuity occurs with 3 elements 1) ability to plan and re-check own ideas, 2) knowledge including the ability to utilize the current information, and 3) thinking skill of critical thinking”. The critical thinking is the necessary skill and extremely vital to the learners’ development.

From the abovementioned value, it is clearly seen that today’s teaching process involves tremendous information. The learners have many learning approaches and gather various forms of information. The teaching process that focuses on critical thinking will sharpen the learners’ abilities to analyze the information received in order to make the right decision. Hence, promoting such process in teaching critical thinking is vital. The students’ new knowledge do not result from the teacher’s narration or from the memory of the old says. But the learning of science method refers to the process that the students have to search, seek, explore and research with all means that students understand and perceive that knowledge with meaningful implications. Then, the students can build up their own knowledge source and store in long-time memory, Yindeesuk and Dachakupt (2005). This leads to this educational and research, with the objective of improving educational process by using virtual field trip with inquiry learning and critical thinking to enhance the science learning achievement of lower secondary students. The integrated technology in virtual filed trip is another complement element to fulfill the in-class teaching and to reduce the limitation of activity outside classroom. The teachers will help in stimulating the capability of learners in seeking information by themselves. This is an alternative in leisure-education development and well-suited with the learners’ ability and quality; which well supports the educational policy and contributes to leverage the national education quality in the future.

2. The Study

These researches have two main objectives; 1) to develop a learning model using virtual field trips with inquiry learning and critical thinking processes to enhance science learning outcomes of lower secondary students, 2) to study the effectiveness of a learning model using virtual field trips with inquiry learning and critical thinking processes, so there are two steps of research project following by the objective of research.

The process in step 1, synthesis and analysis from the literature review about virtual field trips, inquiry theory and critical thinking process. Then used survey form about the problem in science teaching, researcher brought the result from both of process grouped the problems and drafted a model, and which was then subjected to review in a focus group of 26 secondary science teachers. The result of this process was analyzed and used for the improved model of blended learning by using virtual field trips with inquiry learning and critical thinking processes, and final of this step, researcher propose the learning model to the expert for improved a learning model using to try out to the samples. After that, researcher develop virtual field trips website following by the result of components of a learning model. Development the tools for evaluation science learning outcome, science concept, searching skill,
communication and critical thinking skill and then brought to the experts of evaluation and assessment improved before use to try out.

The process in step 2, try out a learning model, the samples are 31 students in grade 8, learning time for 5 weeks, the activity in each week, students learned with face to face as two times per week in classroom and between each week, students did the activity in virtual field trips website. In each activity, the researcher observes the students in science learning outcome and evaluate for pretest and posttest of science concept, searching skill, communication and critical thinking skill. After finished the try out, the researcher conclusion the learning model inform to the expert of education model expert who verified and validated at the final stage.

3. Findings

The result from this research will present into two parts. Part 1, shown learning models that consist of components and processes of a learning model with virtual field trips with inquiry learning and critical thinking processes. Part 2, shown the result from process of try out, the result was summarized briefly:

Part 1, found that a learning model consist of five components: 1) content and activities, 2) virtual field trips medias including video clips, pictures, animations, online diaries, worksheets, activity sheets, and games 3) experts in field trips resources, 4) learning management system for virtual field trips, and 5) assessment and evaluation. There were three steps of learning processes: 1) pre-virtual field trips activities (1 week), 2) during the virtual field trips activities (2 weeks), and 3) post-virtual field trips activities (2 weeks). See a learning model in figure 1.
Part 2, the result from process of try out, there were significant increases in scores of students posttest in comparison to the pretest for all the measuring skills (science concepts, searching, meaningful communicating, and critical thinking) with significance of .05, students are satisfied with learning in a learning model in the highest level, and the experts certified this learning model as appropriate in high level. The result shown in Table 1-4.

Table 1 Science learning outcome score compared between pre-test and post-test

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>S.D.</td>
<td>mean</td>
</tr>
<tr>
<td>Communication (10 points)</td>
<td>5.83</td>
<td>1.26</td>
<td>8.41</td>
</tr>
<tr>
<td>Science concept in Coal (12 points)</td>
<td>8.22</td>
<td>1.17</td>
<td>10.96</td>
</tr>
<tr>
<td>Science concept Coal forming (9 points)</td>
<td>6.09</td>
<td>1.70</td>
<td>8.61</td>
</tr>
<tr>
<td>Retrieval information (5 points)</td>
<td>3.59</td>
<td>0.89</td>
<td>4.86</td>
</tr>
<tr>
<td>Critical Thinking (70 points)</td>
<td>39.61</td>
<td>4.76</td>
<td>42.25</td>
</tr>
</tbody>
</table>

*p < 0.05

From the table 1 shown that there were significant increases in scores of students posttest in comparison to the pretest for all the measuring skills (science concepts, retrieval information, meaningful communicating, and critical thinking) with significance of .05

Table 2 Satisfaction of students about leaning with this learning model

<table>
<thead>
<tr>
<th>Topic</th>
<th>( \bar{X} )</th>
<th>S.D.</th>
<th>Level of Satisfaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>overview of media in virtual field trips</td>
<td>4.50</td>
<td>0.61</td>
<td>highest</td>
</tr>
<tr>
<td>Overview of learning activity</td>
<td>4.54</td>
<td>0.57</td>
<td>highest</td>
</tr>
</tbody>
</table>

From the table 2 shown that students are satisfied with learning in a learning model in the highest level

Table 3 Experts approve a learning model

<table>
<thead>
<tr>
<th>Topic</th>
<th>mean</th>
<th>S.D.</th>
<th>Level of experts opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of model component</td>
<td>4.28</td>
<td>0.53</td>
<td>high</td>
</tr>
<tr>
<td>Overview of learning process</td>
<td>4.36</td>
<td>0.43</td>
<td>high</td>
</tr>
<tr>
<td>Overview of learning apply</td>
<td>4.28</td>
<td>0.32</td>
<td>high</td>
</tr>
</tbody>
</table>

From the table 3 shown the result about the learning model was approved by the experts of education and valid as appropriate in high level.

4. Conclusions

The research results towards the models of virtual field trip organization together with inquiry process and critical thinking, are divided into 3 phases: 1) pre-using the virtual field trips activities, 2) during the virtual field trips activities and 3) post-using the virtual field trips activities. The elements of inquiry process and critical thinking, used in the virtual field trip process, inquiry process, synthesized from BSCS (2006), IPST (2004),
Llewellyn (2002), is consisted of 5 stages: Engagement, Exploration, Explanation, Elaboration, and Evaluation. Critical thinking process, synthesized from Ennis and Millman (1985), Nitko (2004), Facione (2004), Garrison (2007), Sriwongkol (2007), is consisted of 5 stages: Stimulation, Problem-Identification, Assessment, Evaluation and Conclusion. The process of learning consist of three phase; 1) pre-using the virtual field trips activities (1 week), 2) during the virtual field trips activities (2 weeks) and 3) post-using the virtual field trips activities (2 weeks). As a consequence, the research finds that there were significant increases in scores of students posttest in comparison to the pretest for all the measuring skills (science concepts, searching, meaningful communicating, and critical thinking) with significance of .05, students are satisfied with learning in a learning model in the highest level, and the experts certified this learning model as appropriate in high level.

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