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Development of blended learning model with virtual science laboratory for secondary students

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Abstract

This study is conducted in terms of research and development aiming for developing blended learning model using project-based learning via virtual science laboratory in a science classroom for students in secondary schools. The model could lead students to understand sciences lessons easier and enable to do experiments in lesser time, and encourage them to create new further experiments with curiosity. In addition, the model combines face-to-face learning and learning on online network to optimize the advantages of both methods. The research process is divided into 2 phases: 1) the development of blended learning model using project-based learning via virtual science laboratory, and 2) the affirmation of blended learning model using project-based learning via virtual science laboratory. The research samples are five experts selected by purposive sampling. The research instruments are the model of blended learning model using project-based learning via virtual science laboratory, and the evaluation of the model's appropriateness analyzed by means and standardized deviations statistically. The research result shows that: 1. There are five modules in the model which are 1) Student Module 2) Instructor Module 3) Blended Learning Module from Project-Based Learning and Active learning for students to conducting science projects and to check how much they understand what they have learned 4) Virtual Laboratory Module and 5) Assessment Module. 2. The five experts assessed the instruction model, and pointed out that the developed instruction model is highly appropriate. This shows that the developed instruction model can be used for enhancing analytical thinking skills and evaluation of ability in conducting science projects for secondary students.

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Keywords: Blended Learning; Virtual Science Laboratory; Science

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1. Introduction

Most important problems in teaching science in middle school are students lack basic knowledge, schools' laboratories are not well equipped, and subject matters are hard to understand. A survey of teacher opinions also highlighted problems of students not paying attention to the subject, schools lacking standard tools and equipment for teaching, students not understanding science, and schools lacking laboratories (Niparat Witee, 2010). As a result of such problems, a virtual laboratory has been developed to allow students to conduct an experiment several times, to save cost, and to protect students from dangers that could arise when performing a real experiment. According to an article "Physical and Virtual Laboratories in Science and Engineering Education", published in a Science Education issue of Science magazine, it was found that science learning of students of every age group required a scientific investigation part. Applying virtual laboratories in scientific experiments has a number of advantages: they are easy to use, require little time, and allow students to perform several experiments within a limited time and carefully plan their future experiments. Teachers can also use students' experiment data (stored in a computer) to design a group discussion in class, prepare a next lesson, or identify students who need extra tuition. Moreover, they can help students understand things that are not possible to experiment in real life, e.g. a geomagnetic reversal and effects of heart rates (Wijarn Panich, 2013). Accordingly, in order to increase students' participation in learning and facilitate learning at any time and place at their convenience via computer network, I would like to develop a virtual laboratory of the same quality as a real laboratory, where students can test their hypothesis and observe the test result without risk of possible dangers from a real experiment or high cost and prepare themselves for an experiment in a real laboratory, which would result in students experiencing and understanding scientific principles by themselves, thus means better learning and thinking skills of the students (The Virtual Campus, 1998; Tanormporn Loahacharussang, 2002; Boonker Kuanhavech, 2010).

Analytical thinking is an important skill students should keep practicing until it becomes habit in order to enhance their knowledge, experience, and thinking skill thoroughly (Niramon Satawut, 2005). Analytical thinking happens when we try to find a causal explanation of a situation or phenomenon, to assess and make a suitable choice, and to see a big picture of something (Amparat Nualtong, 2011). Science helps humans advance their thinking process, i.e. causal thinking, creative thinking, and analytical thinking; knowledge seeking skills; systematic problem solving; and decision making basing on a variety of information and verifiable empirical evidences. An objective of the Department of Science is to provide students with science education that focuses on connecting knowledge with process, developing students' research skill, knowledge construction skill, and problem solving skill, and encouraging their participation in class with suitable activities for each age group.

In a strategy of blended learning, traditional education will be adopted together with online learning technologies, e.g. learning management system, video broadcasting, desktop video conference, and interactive communication tools to enhance students' participation and exchange of knowledge, while valuable class time will be used for developing thinking skills and necessary attitude toward learning of students. According to the strategy, 30-79% of the course content will be delivered online and the other 21-70% will be delivered face-to-face in class. Integral elements to a successful mix between virtual and traditional classrooms are contexts of classroom, content format, course activities, and evaluation methods (Graham, 2006; Rochester, 2004; Dam, 2003; Thorne, 2003; Carman, 2002; Collis & Moonen, 2001). Even though online learning makes it earlier for students to access to knowledge at any time and place, teacher and student communication in a face-to-face learning is also important. Consequently, the blended learning is an effective strategy that can combine best methods of both real world and virtual world (Siew-Eng, 2010).

Therefore, the researcher had an idea to develop the developing blended learning model using project-based learning via virtual science laboratory in a science classroom for students in secondary schools., which would encourage group learning and help improve analytical and rational thinking, problem solving, and decision making skills of students, both in class and in real life.

2. Propose of the study

2.1. To develop the blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students.

2.2. To evaluation the appropriateness of the blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students.

3. Scope of the study

3.1. Population:

The study population was expert in computer education, information and communication technology, instructional design and educational research.

3.2. Sample Group:

The samples are 5 experts in computer education, information and communication technology, instructional design and educational research selected by purposive sampling who have more than 3-year experiences in the related fields.

3.3. Variables of the study:

3.3.1 An independent variable is the blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students.

3.3.2 A dependent variable is the evaluation result of the model's appropriateness

4. Methodology

4.1. The first phase

The first phase was to develop blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students with the following method:

4.1.1 Development of the model of blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students by using data collected from studies and analyses of relevant documents and researches.

4.1.2 Propose the blended learning model to advisor for considering and revising in accordance with recommendations.

4.1.3 Propose the model to the experts through in-depth interviews.

4.1.4 Create an evaluation tool to evaluate the appropriateness of the model.

4.2. The second phase

The second phase of the project was an evaluation of the blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students. The process is as below:

4.2.1 Propose the developed model to 5 experts in the field of computer education, information and communication technology, instructional design and educational research. The experts will consider and assess the appropriateness of the model, and then the researchers will modify the model in accordance with the experts' suggestions.

4.2.2 Analyze the results from the evaluation of the model's appropriateness by using means and standardized deviations statistically. The evaluation form is built upon 5-point Likert Scale; that is, very good, good, moderate, poor and very poor.

5. Result

The result of this research is divided into 2 parts.

Part 1 The blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students is illustrated in Fig. 1.

5.1. The Components of blended learning model using project-based learning via virtual science laboratory was composed of fives modules is shown in Figure 1 as follows:

5.1.1 Student Module – Recording and storing students' information in the database, which includes registration, pre-test results, learning process, tests, project activities, and post-test results.

5.1.2 Instructor Module – Recording and storing teacher's information in the database.

5.1.3 Blended Learning Module – Providing learning procedures from the beginning until the end.

1) Course Introduction
2) Course content
3) Learning objects, learning technology, and learning resources
4) Learning activities
5) Communication and Interaction
6) Scaffolding
7) Assignments
8) Participation
9) Evaluation

This research includes project-based learning strategy will help develop students' ability in conducting a science project and assess students' understanding of the subject matter, while an active learning strategy will provide students with activities and communication technologies that encourage analytical thinking and group process.

5.1.4 Virtual Laboratory Module – Providing tools for conducting an experiment before starting a science project.

1) Couse and content introduction
2) Problem or question introduction
3) Discussion and Collaborative Learning
4) Links to other learning resources and case studies
5) In-house three-dimensional virtual laboratory
6) Online scaffolding

5.1.5 Assessment Module – Providing tools for assessing students' performance and reporting their progress, which includes knowledge evaluation, analytical thinking evaluation, and science project evaluation.

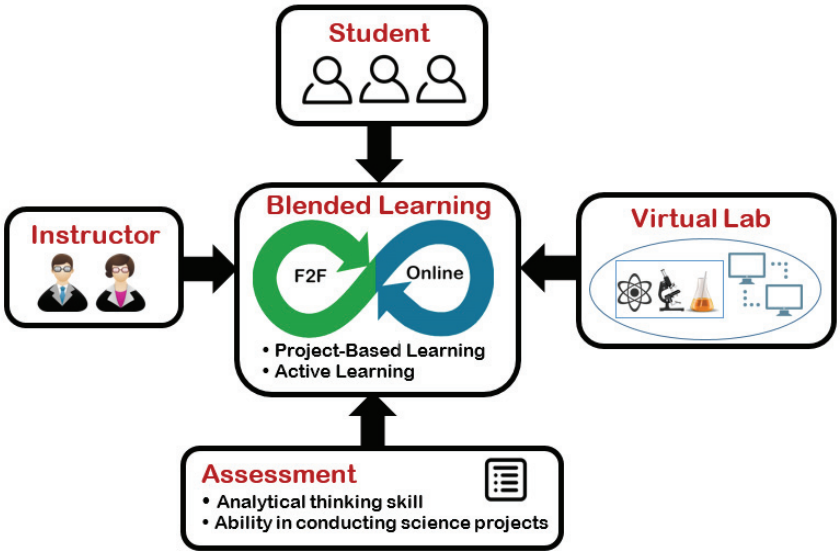

Fig 1.The Model of blended learning using project-based learning via virtual science laboratory

Part 2 The evaluation results of the appropriateness of the blended learning model using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students

Table 1. The evaluation result of the developed instruction model.

Aspects	Mean	S.D.	Interpretation
1. Components of the model are appropriate for analytical thinking skillss development.	4.00	.447	Good
2. Components of the model are appropriate for evaluation of ability in conducting science projects development.	4.20	.374	Good
3. The model's process are appropriate for analytical thinking skillss development.	4.00	.316	Good
4. The model's process are appropriate for evaluation of ability in conducting science projects development.	4.40	.400	Good
5. The blended learning model using project-based learning via virtual science laboratory can be apply in science learning.	4.60	.245	Very Good
Summary	4.24	.306	Good

According to Table 1. , the total average scores is 4.24 (S.D. = .306) at a good level, that means all experts agree with the appropriateness of the synthesized model and can be used the model to create blended learning using project-based learning via virtual science laboratory in order to enhance analytical thinking skills and evaluation of ability in conducting science projects within secondary students.

6. Discussion of result

This model integrated a variety of learning methods. A virtual laboratory was mixed with blended learning and information technologies to maximize effectiveness of a course. Meanwhile, project-based learning was also used in this framework to encourage group learning and develop students' analytical thinking skill. Project-based learning allows students to do a research and conduct an experiment on a topic of their interest and ability under supervision of a teacher; yet, this learning method is not popular among schools because teachers do not usually have time to supervise a project for each student. Another strategy deployed was active learning, which provides a number of learning activities to encourage students to participate in class in order to improve their thinking skills, e.g. analysis, synthesis, and assessment; communication skills, e.g. listening, speaking, reading, and writing; and social skills, e.g. interaction with friends and teacher. Active learning can also increase students' interest and attention to a lesson. Using this learning strategy, students will be able to evaluate their own learning outcomes, while teachers will able to evaluate their teaching from students' feedback as well (Bonwell and Eison, 1991; Lorenzen, 2001). All these strategies can be adapted for future teaching. For the next process of this research, a concrete and effective conceptual framework will be extracted by specialists and subsequently developed into a curriculum for a trial operation.

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