

Development of Blended Learning Model Utilizing Project-Based Learning to Enhance Creative Thinking and Science Process Skills of Mattayomsueksa 2 students

การพัฒนารูปแบบการเรียนรู้แบบผสมผสานโดยใช้การเรียนรู้ด้วยโครงงานเพื่อส่งเสริมความคิดสร้างสรรค์ และทักษะกระบวนการทางวิทยาศาสตร์ของนักเรียนชั้นมัธยมศึกษาปีที่ 2

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Abstract

To promote students using information technology in the learning process is the important strategy of the ministry of education. Utilization of technology is necessary to access the knowledge and information sources which are important for the producing process and development. It is important to provide the proper learning process for youth and students. They can then use the proper technology to access the information and knowledge sources which are important for learning and development, leading to the creative thinking. The development of blended learning model using the project-based learning to enhance creative thinking and science process skills for Mattayomsueksa 2 students was conducted. The research aims: 1) to develop a web-based instructional learning model, 2) to investigate the blended learning model that improves creative thinking and science process skills. The programme recruited three sample groups including 217 teachers, 7 educational expertise, and 370 students. The research employed 4 research tools comprising of 1) blended learning programme, 2) the creative thinking test for Sciences and 3) the test of process management for Sciences and 4) the learning achievement test. The data were analyzed by Percentage, Mean, Standard Deviation and Dependent T-test. The results and findings were as follows: 1. Blended learning model utilizing project-based learning to enhance creative thinking and science process skills for Mattayomsueksa 2 students which included principle, objectives, instruction and evaluation as well as three learning steps: 1. Learning preparation, Learning activities and Learning evaluation. 2. Evaluating experts give high score for the developed learning model (mean = 4.29, SD=0.69).

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3. Blended Learning Model has been significantly satisfied by the student (mean =4.73, SD =0.88) (p-value < 0.001).

In conclusion, the Blended Learning Model of the project learning had enhanced Mattayomsueksa 2 students for creative thinking and science process skills, which allows students to improve knowledge achievement. Therefore, teacher and stakeholder should be prompted to support and encourage the student for their sustainable learning.

Keywords : Blended Learning Model, Project-Based Learning, Creative Thinking, Science

บทคัดย่อ

การพัฒนารูปแบบการเรียนรู้แบบผสมผสานโดยใช้กระบวนการเรียนรู้ด้วยโครงงานเพื่อส่งเสริมความคิดสร้างสรรค์และทักษะกระบวนการทางวิทยาศาสตร์ของนักเรียนชั้นมัธยมศึกษาปีที่ 2 ในครั้งนี้มีความมุ่งหมายเพื่อ 1) พัฒนารูปแบบการเรียนรู้แบบผสมผสานโดยใช้การเรียนรู้ด้วยโครงงาน เพื่อส่งเสริมความคิดสร้างสรรค์และทักษะกระบวนการทางวิทยาศาสตร์ของนักเรียนชั้นมัธยมศึกษา ปีที่ 2 2) ศึกษาผลการใช้รูปแบบการเรียนรู้แบบผสมผสานโดยใช้กระบวนการเรียนรู้ด้วยโครงงาน เพื่อส่งเสริมความคิดสร้างสรรค์และทักษะกระบวนการทางวิทยาศาสตร์ของนักเรียนชั้นมัธยมศึกษาปีที่ 2 กลุ่มตัวอย่างที่ใช้ในการวิจัยในครั้งนี้มี 3 กลุ่ม ได้แก่ กลุ่มที่ 1 นักเรียนชั้นมัธยมศึกษาปีที่ 2 จำนวน 370 คน และครูวิทยาศาสตร์ ปีการศึกษา 2557 จำนวน 217 คน กลุ่มที่ 2 ผู้ทรงคุณวุฒิ จำนวน 7 ท่าน และกลุ่มที่ 3 นักเรียนชั้นมัธยมศึกษาปีที่ 2 โรงเรียนจุฬารัตนราชวิทยาลัยบุรีรัมย์ สังกัดสำนักงานเขตพื้นที่การศึกษามัธยมศึกษา เขต 32 จำนวน 30 คน เครื่องมือที่ใช้ในการวิจัย ได้แก่ 1) รูปแบบการเรียนรู้ที่พัฒนาขึ้น 2) แบบทดสอบวัดความคิดสร้างสรรค์ทางวิทยาศาสตร์ 3) แบบทดสอบวัดทักษะกระบวนการทางวิทยาศาสตร์ 4) แบบทดสอบวัดผลสัมฤทธิ์ทางการเรียน สถิติที่ใช้ในการวิเคราะห์ข้อมูล ได้แก่ ร้อยละ ค่าเฉลี่ย ส่วนเบี่ยงเบนมาตรฐาน และ Dependent t-test. ผลการวิจัยพบว่า 1. รูปแบบการเรียนรู้แบบผสมผสานโดยใช้กระบวนการเรียนรู้ด้วยโครงงานเพื่อส่งเสริมความคิดสร้างสรรค์และทักษะกระบวนการทางวิทยาศาสตร์ของนักเรียน ซึ่งประกอบด้วย หลักการของรูปแบบวัดประสงค์ของรูปแบบ กระบวนการเรียนการสอน และการวัดผลและประเมินผล โดยขั้นตอนกระบวนการเรียนการสอน มี 3 ขั้นตอน ได้แก่ ขั้นเตรียมก่อนการเรียน ขั้นการจัดกิจกรรมการเรียนการสอน และขั้นการวัดผลประเมินผล ส่วนกิจกรรมการเรียนการสอน มี 6 กิจกรรม ได้แก่ ขั้นการนำเสนอหัวข้อ ขั้นการวางแผน ขั้นการปฏิบัติโครงงาน ขั้นการสรุปผล ขั้นการนำเสนอผลงาน และขั้นการประเมินผล 2. ผู้เชี่ยวชาญประเมินความเหมาะสมของรูปแบบการเรียนรู้ที่พัฒนาขึ้นอยู่ในระดับมาก ($\bar{X} = 4.29$, $SD=0.69$) 3. นักเรียนที่เรียนด้วยรูปแบบการเรียนรู้ที่พัฒนาขึ้นมีความคิดสร้างสรรค์ ทักษะกระบวนการทางวิทยาศาสตร์ และผลสัมฤทธิ์ทางการเรียนหลังเรียนสูงกว่าก่อนเรียนอย่างมีนัยสำคัญทางสถิติที่ระดับ .01 โดยสรุปรูปแบบการเรียนรู้แบบผสมผสานโดยใช้การเรียนรู้ด้วยโครงงานส่งผลให้นักเรียนชั้นมัธยมศึกษาปีที่ 2 มีความคิดสร้างสรรค์ ทักษะกระบวนการทางวิทยาศาสตร์และผลสัมฤทธิ์ทางการเรียนสูงขึ้น ดังนั้น ผู้สอนและผู้มีส่วนเกี่ยวข้องควรส่งเสริมสนับสนุนและกำหนดแนวทางการพัฒนารูปแบบการเรียนรู้การสอนให้ดียิ่งขึ้นซึ่งจะช่วยให้นักเรียนได้รับประโยชน์สูงสุดตามไปด้วย

คำสำคัญ : รูปแบบการเรียนรู้แบบผสมผสานการเรียนรู้โดยใช้โครงงานความคิดสร้างสรรค์ทักษะกระบวนการทางวิทยาศาสตร์ นักเรียนชั้นมัธยมศึกษาปีที่ 2 จังหวัดบุรีรัมย์

Introduction

The educated society and the intellectual economy are the main stream for the development process of the international community. To promote students using information technology in the learning process is the important strategy of the ministry of education. Utilization of technology is necessary to access the knowledge and information sources which are important for the producing process and development. The youth and students are the new generation where the future of the nation be in their hands. It is important to provide the proper learning process for youth and students. They can then use the proper technology to access the information and knowledge sources which are important for learning and development, leading to the creative thinking. It is a higher-order thinking process. The promotion of creative thinking plays an important role for learner centred educational management. This learning format emphasizes the need for learner to express their thinking and doing which is delivered from the learning process that is linking old experiences with new ones to create unique works or outputs leading to new discoveries (1). Moreover, creative thinking can be adapted and used to improve daily life activities effectively. It exists in everyone and this skill can be promoted to the higher level of development (2). Everyone possesses creative thinking to a certain degree (3). It is a thinking process that is sensitive to problems or what is lacking and how to solve them. It is a phenomenon that is limitless, nor is it confined to only some individuals. There are several types of creative thinking and they can be taught, practiced and the outputs are many and varied without limitation (4). Science process is essential in developing a good quality of life. It can be used to solve daily problems effectively. By developing science process skills, not only can students learn scientific facts and concepts, they also can achieve intelligence from practice (5). Science process skill is a systemic thinking process, employing all five senses to seek knowledge and develop problem-solving skills. By utilizing project-based learning, students are encouraged to learn naturally and engage in science process, which enhances creative thinking and science process skills acquisition. Present learning activities are still mostly carried out by giving the lecture in the classroom, students rarely have a chance to practice thinking skills. There is a lack of education media which encourage students to learn outside the classroom or at home and students cannot apply what is learned in the classroom to develop creative thinking. The majority of students are unable to apply the knowledge learned from classroom to develop the critical thinking, thinking synthesis, judgment, creative thinking, consideration and vision. According the requirement of the ministry of Education, the following criteria are required. The fourth standard of the basic education standard requires the learner having the ability for critical thinking, synthesis thinking, judgment, creative thinking, consideration and vision. The fifth standard requires the learner having skills according to the study programmed and the sixth standard require that the learner having the skill of self-training and engage in the continuing education and

lifelong learning. During years 2011-2015, the regional education zone has been assessed for the third round by the external quality assurance office (EQA). The overall result showed that on the fourth attributes: rational thinking, creative thinking, process thinking and vision was low and needed to be remedied while the fifth attribute of effective learning was adequate (53.14%). The sixth attribute: the child centered learning was adequate (0.28%).

Following the third assessment result, the EQA suggested the school should improve its teaching process which would improve the skill and quality of students according to the standard of educational program and also improve the students skill on critical thinking, thinking synthesis, judgment, creative thinking, consideration and vision. In year 2013 the result from the national evaluation of basic education (O-Net) reported that the O-Net's mathematics evaluation for Mattayomsueksa 2 students was also downgraded to the low level. The factors that caused this result were 1) There is not enough teachers. 2) The teacher teaches a subject which is not related to their expertise. 3) The media and equipment is insufficient. Therefore it is important to encourage students to concentrate on their examination, teacher with their expertise related to the educational program and the school with proper teaching media and equipment.

In year 2013, the result of the assessment in the science subject of Mattayomsueksa 2 students in the educational jurisdiction area 32 was lower than the standard (38.62%). Therefore researchers were, thus, interested in developing a blended learning model using project-based learning to enhance creative thinking and science process skills acquisition in Mattayomsueksa 2 students.

Objective

1. To develop a blended learning model utilizing project-based learning to enhance creative thinking and science process skills acquisition in Mattayomsueksa 2 students.
2. To study the results of blended learning model utilizing project-based learning to enhance creative thinking and science process skills acquisition in Mattayomsueksa 2 students.

Hypothesis

1. The Students taught by a blended learning model utilizing project-based learning to enhance creative thinking and science process skills acquisition in Mattayomsueksa 2 students increases their creative thinking skill
2. The Students taught by a blended learning model utilizing project-based learning to enhance creative thinking and science process skills acquisition in Mattayomsueksa 2 students increases their science process skills.

3. The Students taught by a blended learning model utilizing project-based learning to enhance creative thinking and science process skills acquisition in Mattayomsueksa 2 students have achieved the learning output.

Methods

The blended Learning model using project-based learning to enhance creativity and science process skills of student was designed using One group Pre-test Post-test experiment in the of Mattayomsueksa 2 students and the science teachers of the regional educational jurisdiction area 32. This study is including 3 phases:

Phase 1: Learning model development: The development of a blended learning model using project-based learning to enhance creativity and science process skills of Mattayomsueksa 2 students were composed by the following step:

1) Literature review on a blended learning model and project-based learning and then the conceptual framework was designed from the analysis and synthesis the data earning from related documents, theory, and research related to the development of blended learning. The synthesized framework was comprised of 1) the blended learning model using the concept of Thorne (2003); Clark (2003); Horne (2003); Carman (2005) (6-9). The model was combined of a classroom instruction (face-to-face), web based instruction (WBI) and live-e-learning. 2) the project based learning process using the concept of Katz and Chard (1994); Baert (1999); Hyosook et al., (2008) which consists of 1) propose the project 2) planning 3) action 4) make a conclusion 5) presentations 6) assessment (10-12)

2) A survey of the requirement and the format of a blended learning using project-based learning to enhance the creativity and science process skills of Mattayomsueksa 2 students. The population in this study which included 494 science teachers and 12,898 Mattayomsueksa 2 students under the educational jurisdiction area 32, the study was conducted during the first semester of the academic year 2013. Therefore 217 science teachers and 370 Mattayomsueksa 2 students were randomly sampled using the table of Krejcie and Morgan (referred by (13). The variable studied was a learning condition and a requirement of a blended learning using project- based learning pattern. The data was collected using questionnaires which evaluated for content validity and index of congruence. The data was analyzed using descriptive statistic including frequency, percentage, Mean and standard deviation. The scoring system referred to Boonchom Srisard (2003) as following degree: 5 means strongly agree, 4 means agree, 3 means moderately agree, 2 means disagree and 1 means strongly agree. The interpretation rate were 4:51 to 5:00 means strongly agree, 3:51 to 4:50 means agree 2:51 to 3:50 means moderately agree, 1:51 to 2:50 means disagree and 1:00 to 1:50 means disagree strongly (14).

3) The design of a blended learning model using project-based learning to enhance creativity and science process skills of Mattayomsueksa 2 students was comprised

of 2 steps including 1) the format of a blended learning model using project-based learning to enhance creativity and science process skills of Mattayomsueksa 2 students including 3 parts 1: the details of learning process 2: learning process 3: learning process observation plan. 2) The learning model utilization criteria.

4) The invention design and quality assessment was conducted as follows - steps: 1) the experimental invention includes a) web-based lessons of science project entitled Life and Environment for Mattayomsueksa 2 students using Moodle LMS program b) the learning model was edited and evaluated by the thesis advisory committee. c) the learning model was corrected following their comments and suggestions. 2) The data collection using questionnaires for the evaluation

a) The teaching documents and learning format was evaluated for its appropriation of learning format using 5 scale rating (15)

b) The learning media and equipments was evaluated using 5 scale rating in 3 categories as context, web-based lessons design and web-based learning administration.

3) The progression of creativity was evaluated using the scoring system of Guilford (1988) and Torrance (1971) in 4 categories comprising initiative thinking, flexible thinking, rapidity thinking and finery thinking (3, 4). 4) The achievement of learning output was evaluated using the examination question according to the context of the subject following the learning evaluation process of Srisa-ard (2553) (13).

5) Student's science process skills were evaluated for 13 science skills with 60 questions. The assessment sheet was designed and validated according to criteria of the institute of science and technology teaching promotion.

Phase 2 : Model Validation: The effectiveness of a blended learning model using project-based learning model was evaluated. The learning model was evaluated by the expertise committee that comprised of 2 information technology specialists, 2 learning context specialists, 2 evaluation and assessment specialists and 1 psychologist. Following the evaluation process the validated learning model was trialed in the 30 Mattayomsueksa 2 students from Satuek district school who were purposely sampled into the test. Data was collected and analyzed using descriptive statistic. The mean with standard deviation of the data illustrated that the designed learning model reach the standard criteria as 80/80. Therefore the blended learning model using project-based learning model was then used in phase 3 of the study.

Phase 3 : Model application: The effects of a blended learning model using project-based learning model on creativity and science process skills of Mattayomsueksa 2 students on the creative thinking and science process skills acquisition has been applied and evaluated. The One group Pre-test Post-test experiment was designed and used to evaluate the effect of project-based learning model. Thirty of Mattayomsueksa 2 students were purposely sampled from the population of 193 Mattayomsueksa 2 students from the

Princess Chulabhorn college high school under the educational jurisdiction area 32. The study was conducted during the second semester of academic year 2014. The 30 of Mattayomsueksa 2 students participated and engaged in the designed learning model including web-base learning , face-to-face instruction and project based learning. The assessment of creativity, science process skills acquisition and the learning output achievement had been evaluated prior and post the experiment.

Statistical analysis

The data were analyzed using descriptive analysis (means and standard deviation), pre- and post-learning tests comparison using dependent samples T-test.

Results

Phase 1: The development of blended learning model using project-based learning model

Phase 1 of the research allowed the researcher to investigate the general information relating to the study model including the overall information of Mattayomsueksa 2 students and science teacher who were responsible for the subject life and science. The study illustrated the information as following.

1.1 General information: The result showed under the educational jurisdiction area 32 there are 186 girl students (50.30%) and 184 boy students (49.70%). The evaluation of student's opinion on the information technology knowledge and communication illustrated that teacher should be present at the computer laboratory at all times, there is internet available at school and the school website. The students used internet for searching the information online. However, there are fewer students using the online lesson provided.

1.2 General knowledge and recognition in a blended learning model of Mattayomsueksa 2 students under the educational jurisdiction area 32

The results showed that most students had a face-to=face learning model (100%) and 95.15 of students understood what is the face-to-face lesson. On the other hand, there were 40.8% of students who took the blended learning lesson and there was 43% of students recognized the blended learning lesson. The information earned led to the design of a blended learning model effectively.

1.3 General knowledge and recognition in project based learning model of Mattayomsueksa 2 students under the educational jurisdiction area 32

There was 96.8 % of students wanting to take a project based learning lesson. Also 91.1% of students used to take the lesson and activity related to a project based learning lesson. However there were 60.5% of students knew of a project based learning lesson and 59.2 % of students knew the basic activity of a project based learning lesson.

Phase 2: Model Validation: The relevance of a blended learning model using project-based learning model was evaluated.

2.1 committee evaluation : The committees evaluated that the consequence of the lesson activities had highly appropriated. The committees reported that most appropriated step was the study output evaluation and assessment and then the preparation prior taking the lesson and the least was the lesson learning process. Overall the evaluating expertise committee gave high score for the developed learning model, suitable to be used to teach Mattayomsueksa 2 students.

2.2 The tryout of the learning model : The designed blended learning model was tried out with Mattayomsueksa 2 students at Stuek district secondary school where the effectiveness criteria (E_1/E_2) was 80/80. The result showed the effectiveness score for the designed blended learning model was 84.42/82.33 (E_1/E_2) therefore the developed blended learning model using project-based learning (Figure 1) was appropriate and can be used in phase 3 of the experiment .

Phase 3: The blended learning model using project-based learning Model application

1. The comparisons of the creative thinking score (Mean \pm SD) of Mattayomsueksa 2 students pre and post participation the blended learning model using project-based learning

The Mattayomsueksa 2 students that studied the life and science subject using the blended learning model using project-based learning have significantly increased creative thinking score ($P<0.01$) when compared to their score prior the learning. (Table 1)

2. The comparisons of the science process score (Mean \pm SD) of Mattayomsueksa 2 students pre and post participation the blended learning model using project-based learning

The Mattayomsueksa 2 students that studied the life and science subject using the blended learning model using project-based learning have significantly increased science process skills score ($P<0.01$) when compared to these score prior the learning. (Table 2)

3. The comparisons of the learning output achievement (Mean \pm SD) of Mattayomsueksa 2 students pre and post participation the blended learning model using project-based learning

The Mattayomsueksa 2 students that studied the life and science subject using the blended learning model using project-based learning have significantly increased science learning achievement score ($P<0.01$) when compared to these score prior the learning. (Table 3)

Figure 1 The recognition in project based learning model of Mattayomsueksa 2 students under the educational jurisdiction area 32

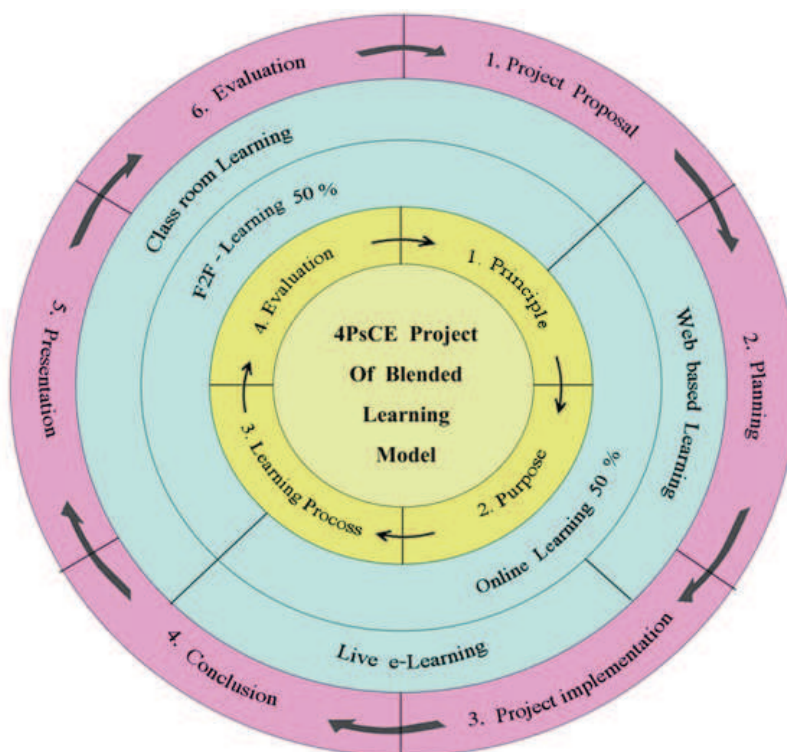


Figure 2 : 4PsCE Project of Blended Learning Model using project-based learning Model application

Table 1 : The comparisons of the creative thinking score (Mean±SD) of Mattayomsueksa 2 students pre and post participation the blended learning model using project-based learning

Creative thinking score	Pre learning		Post learning		df	t	p
	\bar{X}	S.D.	\bar{X}	S.D.			
Rapid thinking	27.03	7.24	57.20	4.49	29	18.94	.000**
Flexible thinking	8.90	1.24	18.17	1.68	29	27.08	.000**
Innovative thinking	28.07	2.19	53.80	3.70	29	33.41	.000**
Finery thinking	31.83	1.87	50.33	2.69	29	37.88	.000**

**statistical different at $P = .01$

Table 2 The comparisons of the science process skills score (Mean±SD) of Mattayomsueksa 2 students pre and post participation the blended learning model using project-based learning

Science process learning score	n	\bar{X}	S.D.	t	p
Pre learning	30	19.13	1.27	37.41	.000**
Post learning	30	34.87	1.90		

** statistical different at $P = .01$

Discussion

This research was to develop the blended learning model using project-based learning to enhance the creative thinking and science process skills for Mattayomsueksa 2 students. The developed blended learning model using project-based learning lesson increased significantly ($P < 0.01$) the creativity score of students after participation the lesson. The creativity of students had been promoted due to the blended learning using project based learning was developed by the combination of the teaching in the classroom (Face-to-Face) together with using Web-based Instruction which students can learn on their own anytime. The studying content was available on the network which student was able to access in the class anytime. These models encouraged students to try and discover the question by them. Moreover there was a live e-Learning where the teacher was available at all times to answer and support if student has questions about the activity in the lesson. Student was allowed to leave the question of opinion on the web board where they were able to discuss the learning activity. The threaded discussions on web board enhance the learning atmosphere leading to the increase of creative thinking. It provided opportunities for students to create a new concept and then fine the alternative solution to solve the problem effectively. The thinking that comes from the learning experience encourages the students to have wider thinking and initiative thinking. Joe (2006) reported that using the combination process for the learning lesson such as the combination of web based or live e-learning and class room instruction (face-to-face) encourage students to get greater output from the study lesson (16) (17). According to the study in the biology subject in the secondary school using the blended learning model, the research showed that a problem-solving skills after the taking the blended learning lesson increased significantly ($P < 0.05$) (18). Students increased understanding in the study context. Moreover they found that students increased their self-control and have the positive attitude toward the blended learning model and enquired the blended learning mode for the further subject. The study of the development of blended learning using web-based model and creative problem solving process to promote creativity and problem solving for students of higher education showed

that the developed blended learning design increased the problem solving skills. Students had significantly higher academic achievement than before taking the lesson ($P < 0.01$) (19).

The studying environment is important for promoting the creative thinking in students. The brain based learning model was investigated to promote the creative thinking of undergraduate students when they took the designing subject. The designed lesson emphasized the proper environment that induced the students to think and solve the designing problem process. The activities challenged students to use their brain to create the solutions in design activity. The developed model showed that student's creative level was higher than before the experiment ($P < 0.05$) (15). We conclude that the teaching process that enhanced the thinking process includes 7 steps: (1) preparation, (2) define the learning goals (3) learning and linking (4) defines the conceptual framework and application (5), adjustment (6) presentation (7) evaluation.

The present study showed that the science process skills of the students increased significantly after taking the blended learning model using project based ($P < 0.01$). Due to the developed learning lesson enhanced students to use the science process skill since the beginning of the activity. The first activity was to propose the experimental subject which students had to review and study the related documents and research the data involved the experimental subject. Then students developed the experiment proposal by explanation, arrangement and make the conclusion leading to the experiment subject. These processes enhanced the student's science process skills such as observation, classification and hypothesis skills. The second activity was to planning the experiment design by the students had to drafted the experiment planning including the main question of the experiment, the objective, variables, methods , grant chart, the benefit of the experiment and reference list. Theses process promoted the practical definition skills, hypothesis development skill and the variable controlling skill. The third activity was to conduct the experimental project. The students conducted the experiment according to a predetermined plan including preparation of equipment and chemical and then defined the chemical used in each step of experiments. This activity allowed students to practice in the calculation, classification and conduct the experiment. The forth activity was the conclusion; the students from each group analyzed data and then wrote the experiment report. The students learned how to select the presentation format and also the language that used for drafting thing the report. They also trained how to critic the experimental result and make the conclusion for the main finding in the experiment. This activity enhances the students to learn and practice how to prepare the data and present the information earned from the experiment. The fifth, presentation, the students chosen the presentation format and then designed the presentation technique. The presentation was in the class meeting where students from others group attended the presentation. The student was enhanced to explain and present the main finding from the experiment. This activity promotes the

communication, skills to convey information, data arrangement skill and learnt how to express their expression. The sixth activity was to evaluation; the study achievement was evaluated by students. They were encouraged to express their opinion each the activities according the project based learning. Students used their own experience to evaluate the learning process. This activity promotes the evaluation skill by express their opinion using the previous experience. The comparisons of the integrated science process skill on the critical thinking and scientific attitude in the fourth year students using a project-based learning model and the investigation skill. The results showed that 1) the project based learning activities and the investigation for the fact in the chemical reactions subject in Mattayomsueksa 2 students had the effectiveness of studying before and after taking the developed lesson at 82.83 / 77.50 and 69.20/67.35 respectively. These results showed that students were making the progress in learning. Moreover the students who took the blended learning lesson increased the overall science process skills significantly when compared ($P < 0.05$) (20). Mittlefehldt and Grotzer (2003) conducted the research using cognitive techniques for the teaching in the density and pressure subject (21). The lesson included the ability to understand (Intelligibility), ability to be trusted (Plausibility) and the wide-applicability. The learning model promoted the self-reflection, question, comparing own question to the others, trust and respect skillsc (22). The students liked the idea of being able to understand the technical knowledge and ability to use their knowledge extensively (23).

The blended learning model, using developed project-based leaning enhance the student's learning achievement. The present study showed that student's learning achievement score increased significantly after students took the blended learning model using project-based leaning ($P < 0.01$). The developed learning lesson was the combination of both face-to-face classroom teaching and the web-based instruction. The developed learning model comprised of 7 steps as 1) Presentation of Topic 2) Planning (drafting the proposal) 3) conduct the project 4) conclusion 5) presentations 6) evaluation. Students had participated the project freely depend on their ability and interest. The learning activity encouraged students to practice on search, trial, invent and create. There were facilities provided for students to learn on their own. In the same time the teachers were available there for giving suggestion or answer the question if the student need. By this learning model, it encourages students who want to discover and experiment. The atmosphere in the classroom enhances students to liberate their thinking and expression. The freedom to think and create their work without the blocking of an idea leads to the higher study achievement score. The blended learning model using the project based learning has showed that it increased the student's learning achievement score in various studies. The developed blended learning activities has been used for teaching the undergraduate student in the analysis and design subject at the Rajamangala University of Technology of Isaan it

showed that the student had significantly greater learning achievement score after the lesson than before taking the lesson ($P < 0.01$) (24). The development of teaching using a blended learning lesson enhanced a self-study in the students, the research showed that students were satisfied to participate in the designed learning model (25). Rovi and Jordan (2004) compared the study achievement output when the student had taken the conventional class instruction, the blended learning model or the web-based learning, the found that the blended learning lesson created the learning community within the students (26). Due to the blended learning lesson was focusing on the student centered model which encourage student to investigate and search for the answer themselves while there were taking part in the learning process.

To sum up, the developed blend learning model using project-based learning enhanced the creative thinking and science process skills of the Mattayomsueksa 2 students. Due to the designed learning model composed by the learning format, teaching preparation process, learning activities that promote the student to express their ideas or action for solving the challenging question. It supported them to create the initiative idea and having boarded mind. Students were able to apply the idea into the practice. They also had the fluency, flexibility, originality and elaboration. Moreover the project-based learning also promoted the use of five sense of studying including analysis, survey, searching and explanation what had been observed. Therefore, the developed learning format is composed by 4 components that are 1) learning format principle 2) learning objective 3) learning process and 4) the evaluation. In addition the learning process is including 3 steps as 1) learning preparation 2) learning and teaching activities and 3) evaluation. Moreover the learning and teaching activities comprise by 6 activities such as 1) experimental proposal 2) experimental planning 3) conduct the experiment 4) conclusion 5) presentation and 6) evaluation.

Suggestion

1. To effectively use the developed blended learning model, researchers recommend :
 - 1.1 Teacher must prepare enough computers for all students. Every PC must be in working condition and be linked to the Internet. Teacher must supervise, suggest and give advice how to use PC effectively.
 - 1.2 Students must be capable of using mouse and keyboard efficiently and must know how to use basic applications including Internet.
 - 1.3 Teacher should introduce new technology as part of learning activities so that students would enjoy study and not get bored, for example, instant messaging apps (Line, Whatsapp, Wechat) so that students can exchange ideas and opinions.

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