

*Full Length Research Paper*

# A Model of e-Learning by Constructivism Approach Using Problem-Based Learning to Develop Thinking Skills for Students in Rajabhat University

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This research aimed to develop a model of e-learning by using Problem-Based Learning–PBL to develop thinking skills for students in Rajabhat University. The research is divided into three phases through the e-learning model via PBL with Constructivism approach as follows: Phase 1 was to study characteristics and factors through the model to develop thinking skills, Phase 2 was to construct the model to develop thinking skills, Phase 3 was to study the effects of implementing from the model to develop thinking skills. The findings found that: There are five factors in the model of e-learning – principle, purpose, learning and teaching process, systematic procedures, and measurement and evaluation. There are nine stages of learning and teaching activities: faced problem, defined problem, defined boundary to collect facts, setting hypothesis, allocated problem topic to group members, group members' collected data, analyzed and synthesized data, decision making, and evaluation. By the learning set through the model of e-learning with problem-based learning in constructivism approach to develop their thinking skills, students at Rajabhat University, as the subject study, significantly achieved their post-test scores more highly than their pre-test at 0.05. Otherwise, the students' opinions on the model used indicated in high degrees. The students in this study significantly showed the development of their thinking skills in higher degree at 0.05.

**Keywords:** e-Learning, Constructivism, Problem-Based Learning –PBL, Thinking skills.

## INTRODUCTION

Currently, education system needs thinking skills for learners to be able to adapt to the changing society in which competition and challenges are affecting their ways of learning. Modern educational management needs to consider various approaches to respond to these needs. Technology in education offers possibility to develop thinking skill among the new generation learners. As a

result, economical and social development aims at producing learners' characteristics to be the potential population of the nation. Thinking skill indentifies the quality of the population.

Education in Thailand is in the process of developing. Various educational reforms are needed. Educational policy suggests that using technology for instruction is

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one of the key successes to improve learning outcomes. There are several learning approaches to develop education. Problem-Based Learning (PBL) is one of the possible solutions. For instance, we can develop content knowledge and critical thinking by integrating online tools based on PBL. The foundation of PBL is also related to Constructivism Theory (Schmidt et al, 2009; Sendag and Odabasi, 2009).

### **Educational Needs in Thailand**

As Thai society has been rapidly evolved, it brings about various changes related to economic, social, political, cultural, and environment. Education reform is needed to cope with these changes. As well, education is considered as a vital tool for national development. Therefore, the development of learners' competency would be the indicator for successful society. According to the National Education Act of B.E. 2542 (1999), revised edition of B.E. 2545 (2002), the objectives of educational management cover the following principles: life-long education, social participation in educational management, on-going development in content and learning process, equality of rights in education, learners-centered education, knowledge actualization, and collaborative learning styles (Phuwidawat, 2002). Moreover, learning by self-reliance and life-long education would contribute to society in terms of knowledge acquisition. This learning approach would make Thai students become analytical, practical, and rational learners. They could adapt skills in analytical thinking synthesizing, management, situational encountering, and knowledge application to assist their lives. They could also employ those skills to prevent or to solve problematic situation in the academic learning. It is inferred that they should know how to analyze, synthesize, and acquire knowledge. Thinking skills, in short, is an important factor in the student life as it is the solution to successful education. Developing of thinking skills is the priority of learners' development toward the quality of people.

### **Technology in Education**

Because information technology has evolved rapidly, learners need to cope with the speed of information evolution. Teachers also need to know how to manage learning tasks using different approaches. For example, Keengwe and Onchwari (2009) say that teachers face multiple challenges on how they can incorporate technology into their instruction. This is essential to consider integration of technological tools for effective instruction and learners' potential development. While Harris and Koehler (2009) argue that integration of educational technology is not only the tools used, but also particularly,

the learning process changes that it brings to the nature of content area learning. Galinsky also states, teachers should encourage students with first hand experiences to enable them to explore and form their own theories. This also gives them a chance to form a community of learners (Galinsky, 2010). Therefore, technology in education deals with integration of the tools to makes changes on learning process based on the objectives to enhance learners' experiences.

### **Problem-based learning in thinking skill development**

Problem-Based Learning (PBL), according to Duch et al. (2001), emphasizes on learners to be able to solve problems systematically. It encourages them to develop quality of thinking, analyzing, and synthesizing. PBL persuades learners to incorporate logic and consideration in making decision. Moreover, PBL assists situational problem solving that students are encountering from teachers' assignment. Students can adopt classroom PBL skill to practice in real life conditions (Wannapiroon, 2008). In the long-run, after gaining extensive skill, PBL would contribute to learners' proficiency which results as the increasing potentials of the nation's population.

Skill levels can be classified into three categories: Basic Level refers to knowing and organizing skills. Intermediate Level comprises applying, analyzing, generating skills. Advanced Level covers integrating and evaluating skills. PBL can be manipulated for developing learners' thinking skills by predicting their learning process through problem solving. Davis and Rimm (1994) and Higuchi and Donald (2002) found that PBL can be a tool to encourage thinking skill. It is necessary to include PBL in appropriate procedure of progression and practice. Application of PBL in practice results in development of thinking skill (Tarasana, 2003). It is important to balance the content alongside with objectives to achieve optimum learning skills and process. Teachers have to test and evaluate learners' thinking skills in appropriate parameters. Thus, using PBL, learners would become the quality students who are able to justify their learning styles according to the changing situation.

PBL and e-learning is a perfect blend of thinking skill development. They can be a cutting-edge instructional tool. Particularly, in current age of instructional media, people across the world are intensively using telecommunication and information technology to search and share knowledge over the Internet. e-learning represents the effective channel for instruction over a large number of learners. Both teachers and learners who employ PBL by using e-learning tools can demonstrate presentations, conduct learning activities, and do interaction over the Internet. Such channel not only connects but also integrates learning content to the learners in the natural and efficient manners. Learners are able to develop their

basic knowledge and thinking skills to achieve their life growth. They also obtain rationalized skills for different ranges; from self-development to social and national development. The optimum merger of PBL e-learning model should blend the implicit knowledge with thinking skill as the learning method.

Consequently, this study is interested in formulating an e-learning model based on PBL and the Constructivism approach in order to develop thinking skill among subject students from Rajabhat University students in Thailand. The study aimed to find out proper components and models for developing thinking skill.

## METHODOLOGY

This study is the research and development work which aimed to formulate the model for PBL online instruction. There are three main phases of methodology as follows:

Phase 1: Study and Survey of Online Instructional Model and Current Online Instruction. There are two steps as follows:

Step 1: Study of characteristics and elements of online instructional model based on PBL Constructivism. This initial phase involves seven areas of scholarly literatures: teaching model, online instruction, Constructivism learning theory, problem-based learning, thinking skills, principles of instructional design, and contemporary conditions and needs of online instruction. These are necessary in formulating appropriate model based on related theories and concepts. The researchers brought the literature reviews for synthesis and analysis to define the research framework and other necessary components.

Step 2: Survey of conditions, usage, and needs in online instruction. The areas of questions covered the application of how to use the Internet for educational and instructional purposes. The possible research framework was administered on two sampling groups: lecturers (n=338) and students (n=375). The population of the lecturers is selected by using Stratified Random Sampling method from total population of 2,732 in 40 Rajabhat University of the academic year 2011. Sampling size is determined by Krejcie and Morgan's table at 95% significant level (Krejcie and Morgan, 1970). Similarly, the population of the students was selected by the same criteria from total population of 14,263 who are studying in the second year in 40 Rajabhat University of the academic year 2011. The sampling of 375 students was based on the proportional allocation method. Subjects from the lectures and students groups were then asked to complete the questionnaires, surveying their current situation, usage, and need in online instruction.

The questionnaire was based on areas indicated by research framework and administered separately between each group. Prior to administration, the questionnaires were validated by the major advisor and three experts who have experience in conducting research in graduate level. It found that each questionnaire yielded the Cronbach's alpha coefficient value of 0.904 and 0.894, respectively.

Phase 2: Development of online instructional model based on PBL Constructivism. Theoretical and designing frameworks are two main concepts concerning PBL, learning resources, and academic strategy. There are three steps as follows:

Step 1: Drafting a model towards informatics theoretical and

designing framework and the survey output of the lecturers and students usage.

Step 2: Examining the properness of the model by the five experts in instructional design. According to Figure 1, the experts suggested to include Constructivism theory to the 3<sup>rd</sup> component because this principle will be the underlying scholarship of how to develop thinking skill of the learners.

Step 3: Constructing tools to accompany the model: online lessons on the Learning Management System –LMS, achievement tests, thinking skill test, and questionnaires.

Achievement test is 4-multiple-choice test; the correct answer value is 1 point while incorrect one is 0. Total questions in this test are 40. It has Difficulty Index between 0.25-0.75, Discrimination Index between 0.24-0.69, and Reliability Index is 0.76. Thinking skill test is 4-multiple-choice test: the correct answer value is 1 point while incorrect one is 0. Total questions in this test are 59. It has Difficulty Index between 0.25-0.79, Discrimination Index between 0.22-0.78, and Reliability Index is 0.72. Questionnaire aimed to survey the opinions of the students who participates in the online instruction. It is 5-level Likert's scale.

The online lesson is constructed on the Moodle LMS platform. Draft of the lesson includes flowchart and storyboard of the problem-based scenarios. It was tested by the major adviser and experts for content and quality prior to implementation.

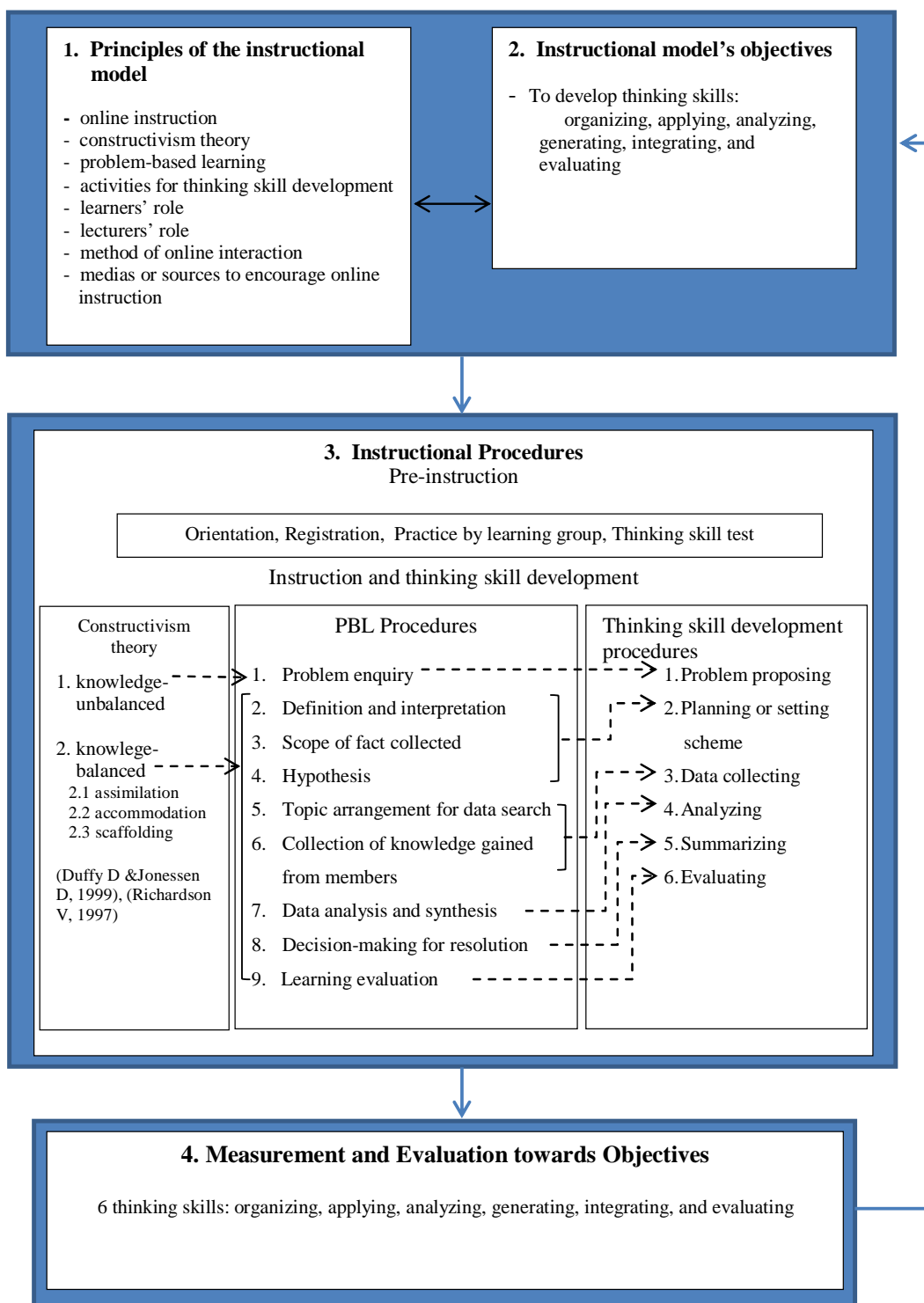
Phase 3: Evaluation of the online instructional model. This aimed to find the effectiveness and efficiency of the model, as well as conditions and processes that enhance the learners. The quantitative method was used by a comparison of scores on learning achievement, thinking skill, and opinion of learners as the users of online instructional model. The sampling group, through cluster sampling method, in this study was 22 undergraduates majoring in computer management, Roi-Et Rajabhat University, academic year 2012 third-semester class enrollment in the course of Information Technology Operation. All students took the course for the first time and separately from the reliability analysis group.

The research tools of the model in phase 3 of online instruction aimed to develop the model, to find out the thinking skill, learning achievement, and users' opinion comprising. The tools were as follows: 1) PBL online instructional model based on Constructivism that encourages thinking skill among Rajabhat University undergraduates, 2) thinking skill test which is covered skills on: organizing, applying, analyzing, knowledge generating, integrating, and evaluating., 3) an achievement test which reflects content knowledge on the course objectives, and 4) questionnaire of the model users which indicates opinions and experiences from using online learning system.

Implementation of the experiment began by introducing learners to online learning model using classroom instruction and various tools such as chat room, web board, and e-mail. There were 12 weeks of the course while 1<sup>st</sup> week was pre-test and 12<sup>th</sup> week was post-test on achievement tests, thinking skill test, and questionnaires. Statistics used are Dependent t-test for achievement test, One-way repeated measurement ANOVA for thinking skill, Mean and Standard Deviation for opinions on model usage. Research design is the One-group Time-series shown in Table 1.

## RESULTS

The characteristics of the developed model focused on essential skills of learning that learners could gain from



**Figure 1.** A model of e-learning by constructivism approach using problem-based learning to develop thinking skills for students in Rajabhat University

their potentialities to proficiencies. It is believed that both of the lecturers and the students are taken their learning together. An instructional scheme should emphasize a

process of knowledge-based from learners; then, the outcome becomes appropriate. Otherwise, a model of social interaction underlines process skills as follows,

**Table 1.** One-group Time-series Research Design.

Group	Time				
	T1, Y1	X	Y2	X	T2, Y3
Experiment					

X = Online Instructional Model; Y1 = 1<sup>st</sup> round of Thinking Skill Test; Y2 = 2<sup>nd</sup> round of Thinking Skill Test; Y3 = 3<sup>rd</sup> round of Thinking Skill Test; T1 = Pre-test of Achievement Test; T2 = Post-test of Achievement Test.

1. The five component model: 1) basic principles, concepts, or theories of the model, 2) objectives of online instructional model, 3) teaching methods and activities, 4) systematization, and 5) model's measurement and evaluation.
2. The two step procedure of instructional management: pre-instruction and instructional organization; then, thinking development.
3. Activities in the instructional scheme involve the integrated steps between PBL and thinking skill learning activities towards nine steps: 1) problem enquiry, 2) definition and interpretation, 3) scope of fact collected, 4) hypothesis, 5) topic arrangement for data search, 6) collection of knowledge gained from members, 7) data analysis and synthesis, 8) decision-making for resolution, and 9) learning evaluation.

The online instructional model was developed by three aspects: concepts, significant components relevant to the study, and situations/ usages and needs of online instruction. Hence, the study components had been set and organized: instructional procedures, measurement and evaluation, conventional assessments, and examination of the online instructional model's effectiveness. In line with constructivism, the components of this online instructional model towards Problem-Based Learning, aiming to encourage thinking skill for the undergraduates from Rajabhat University, can be concluded by the diagram as shown in Figure 1.

The findings of the developed online instructional model can be concluded as follows. The learners of this model obtained higher score achievement in the posttest with .05 statistical significance (Table 2).

The mean score from the thinking skill test from round 1 was 28.77 (SD = 7.37) at 48.76%; the score from round 2 was 32.32 (SD = 6.05) at 54.77%; and the score from round 3 was 36.14 (SD = 6.02) at 61.25% (Figure 2). To demonstrate the development of thinking skill through plotted graph, the means scores from all of the 3 rounds are in Tables 3 and 4.

The undergraduate students who had learned through the developed online instructional model in constructivism towards Problem-Based Learning to encourage the thinking skill showed their higher skill at .01 statistical significance.

The students gave more highly degree of their opinions in this developed online instructional model and the highest degree for overall opinion ( $\bar{X} = 4.53$ , SD = 0.62). The highest degree of the opinion showed in the aspect of 'more lecturers' meeting' ( $\bar{X} = 4.73$ , SD = 0.46) and that of 'more enjoyable learning' ( $\bar{X} = 4.73$ , SD = 0.46); followed by 'more friends' connection' ( $\bar{X} = 4.68$ , SD = 0.57), more enthusiastic in learning ( $\bar{X} = 4.68$ , SD = 0.482), and more eager to learn ( $\bar{X} = 4.64$ , SD = 0.49).

Regarding the students' recommendation for this online instructional model, it is revealed that this kind of learning gave them an opportunity to exchange their learning among friends in the class. They gained more understanding of the lessons and how to use the technology as well as searching for information in practice.

## DISCUSSION

The findings of this study can be discussed as follows. Considering the model of online instruction through constructivism towards Problem-Based Learning –PBL to implement the undergraduate students from Rajabhat University, it was developed by principles, concepts, and theories of online learning, constructivism theory, PBL, and thinking skill; then, analyzed, synthesized, and constructed its learning processes. Subsequently, such model comprises five components: 1) basic principles, concepts, or theories of the model, 2) objectives of online instructional model, 3) teaching methods and activities, 4) systematization, and 5) model's measurement and evaluation.

The teaching method and activities along with this developed online instruction consist of two steps: 1) pre-instruction is the step of learners' preparations by orientation, registration guideline, learning group arrangement, and thinking skill pretest; and 2) the step of instructional organization; then, thinking development with PBL activities through primary seven scales in 10 sub-stages as follows.

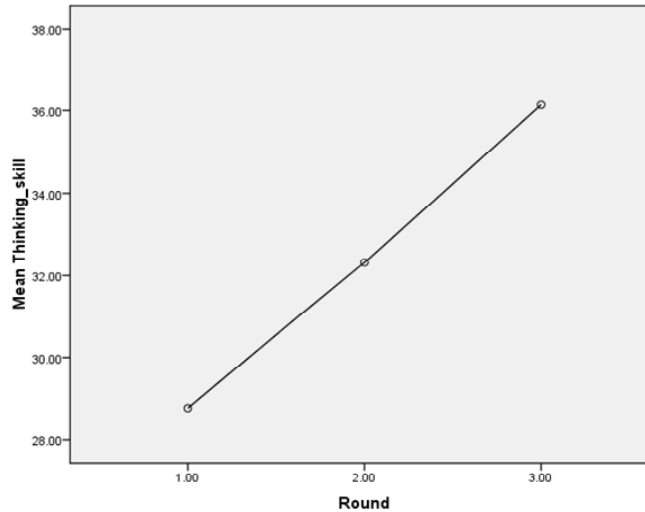
- Stage 1: Content study
- Stage 2: Problem presentation
- Stage 3: Problem solving planning and approach setting; these are- definition and interpretation, scope of fact collection, hypothesis
- Stage 4: Data collection: topic arrangement of data search for group members, collection of knowledge gained from members and applied for resolution
- Stage 5: Analysis: data analysis and synthesis
- Stage 6: Conclusion: decision-making for resolution
- Stage 7: Evaluation: learning evaluation

In reference to the teaching method and activities through

**Table 2.** Result of comparison between Pre-test and Post-test.

Learning output	Pre-test		Post-test		df	t	p
	$\bar{X}$	S.D.	$\bar{X}$	S.D.			
Learning achievement	13.73	4.85	22.36	4.67	21	7.4**	.000

\*\* Statistical significance level at .05



**Figure 2.** The means score of thinking skill test of 3 rounds.

**Table 3.** Mean Score of Thinking Skill Test

Thinking Skill Test	1st Round (Total score 59)	2 <sup>nd</sup> Round (Total score 59)	3 <sup>rd</sup> Round (Total score 59)
Mean	28.77	32.32	36.14
S.D.	7.37	6.05	6.02
%	48.76	54.77	61.25

**Table 4** Result of thinking skill comparison in 3 rounds

Criteria	Value	Hypothesis df	Error df	F	p
Wilk's Lambda	.296	2.00	20.00	23.747	.00

\*\* Statistical significance level at .01

the concept of learning management via webpage, Suriyakrai (2007) proposed two stages of learning procedures: preparation stages comprising orientation, evaluation of learning styles, registration, pretest; and classroom instruction. These are agreeable to Ally's concepts (2004) of various activities for learning on the webpage to achieve its learning objectives. The

developed online instructional model gave higher learning achievement in the posttest statistical significance at 0.05. This showed that learners could develop their learning achievement through this model. In accordance with Bamroongcheep (2008)'s findings in constructivism webpage instruction for creative thinking development, it showed that learners gained higher learning achievement

from the posttest with statistical significance at 0.01. The study of 'Learning management of e-Learning system towards PBL in university level' from Louhapensang (2006) also showed the higher learning achievement in the posttest with statistical significance at 0.01.

The developed model of online instruction initiatively affected the learners' thinking skills. In other words, the learners could develop their thinking skills towards

Problem-Based Learning activities which challenged the learners in their learning processes. Moreover, those activities could fairly respond the diversity of the learners. The problem-based became a learners' stimulus, especially the connections of their former experiences; then the learners were enjoying while studying and were able to search for correct answers in each question. The study of 'an encouragement of advance thinking skills in undergraduate majoring in education' from Khemmani (2006) also found that there were three procedural guidelines to develop the advance thinking skills: 1) Providing factors and environment of thinking such as an encouragement of brain development factors, thinking environment, and characteristics of a thinker; 2) Applying the curriculum/ courses/ programs/ processing media to encourage thinking skills such as directly using media to develop thinking skills and providing courses to promote thinking; and 3) providing learning activities for thinking skill development such as teaching through thinking encouragement styles and integrating the thinking skill with the content learning.

The developed model can be implemented in curriculum by the institutional support. Universities need to establish policy to include e-learning on various courses. Implementation of e-learning can be either partial or total instruction while traditional face-to-face instruction is still necessary.

## Conclusion

This model for online learning based on Constructivism theory could promote thinking skills for university students. As in current Information Age, the nature of teaching and learning is shifting to Web-based instruction, which includes self-paced e-learning and lived e-learning. Therefore, we should develop thinking skills by using a social process. Teaching activities by this model is a blend between PBL and thinking skills development. Results from the implementation of online learning model found that they could develop higher thinking skills with statistical significance level of .05. They also showed significant increasing opinions from learning in online class

## Suggestions

1. Adoption of online instructional model based on PBL

Constructivist approach for thinking skills must be prepared and allocated needed resources adequately and effectively such as software, laboratory, instructional materials, and the Internet network.

2. Instructors and learners need to understand the process of teaching and learning. They have to participate in various activities in group activities and online discussions via chat to enhance knowledge sharing process.

3. Instructors' roles have to be diversified as facilitator, manager, planner, consultant, and assessors of the tasks of learning. Learning independently encourages learner to learn according to the activities in the instructional design.

4. Learners have to actively play a role and realize that learning is a duty. They should be interested in group activities and cooperative learning and sharing knowledge with group members.

## Limitation of this research

The experimental design was limited because there was only one group; no control group in this study. In the future work, the study using model of online teaching based on PBL Constructivism approach should compare the research findings between the experimental group and control group taught in the regular instruction.

## Conflict of Interests

The authors have not declared any conflict of interests.

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