

The Development of Learning Management Activities by Applying Problem-Based Learning Management to Develop Analytical Thinking in Science and Technology Subjects for Grade 9 Students

Submitted 2 February 2023 Revised 28 June 2023 Accepted 29 June 2023

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DOI: 10.30870/gpi.v4i1.19077

Abstract

This research aimed to; (1) Develop learning management activities by applying problem-based learning for grade 9 students in science and technology subjects, meeting the 70/70 criteria. (2) Develop analytical thinking among grade 9 students to meet the 70 percent threshold. Moreover, (3) study satisfaction with learning management by applying problem-based learning. The researchers developed learning management activities for grade 9 students in science and technology courses in this research by applying problem-based learning. The tools used in the research include; (1) Learning Management Plan 5 Plans. (2) analytical thinking Tests. Moreover, (3) satisfaction questionnaires. Statistics used to analyze the data include percent average and standard deviations. The sample groups used in the research are grade 9 students and 23 students from a school in Kalasin province, Indonesia. They were collected by; (1) Analytical thinking Test 30 items. (2) Satisfaction assessment 10 items. The research results showed; (1) The development of learning management activities by applying problem-based learning for students in grade 9 in science and technology subjects to be effective 72.12/70.76, higher than the specified threshold of 70/70. (2) The development of analytical thinking accounted for 71.51%. Meet the 70 % threshold. It shows that managing learning by applying problem-based learning can develop analytical thinking. Moreover, (3) Students are satisfied with learning management by applying problem-based learning. It averaged 4.74, with the highest level of satisfaction.

Keywords: Problem-Based Learning Management, Analytical Thinking, Satisfaction

INTRODUCTON

Analytical thinking is a Basic thinking skill of great importance for human development in the social field, technology & education (Kuhn, 1999). Individuals with less analytical thinking skills can also have a negative impact on their livelihoods. Such importance is therefore tested Program for International Student Assessment (PISA) to measure international student knowledge. It focuses on measuring analytical thinking skills. Thailand is one of the countries that also take the PISA exam. Most recently, in 2018, 79 countries took the PISA exam. Thailand has the 66th PISA ranking in the world. The regional level is 20th, and ASEAN is 10th by science score. It emphasizes analytical thinking skills. It is equal to 426 points (OECD, 2018). Learning management used to develop analytical thinking skills of learners mainly uses active learning management, including Problem-based Learning (Syaiful et al., 2021), Creativity-based Learning (Trisdiono et al., 2019), 5E (Anggraeni and Suratno, 2021), as well as Project-Based Learning (Anazifa and Djukri, 2017).

Learning management appropriate to the school context is linked to success in developing learners' abilities and skills. While observing learners at a school in Kalasin Province, it was

found that the 5E learning management used did not positive effect analytical thinking. When the researcher used the analytical thinking test to test graders 9 students, it was found that 85.71 % of students did not pass the analytical thinking criteria at 70 % set. Self-learning is an important factor in developing analytical thinking skills.

Problem-based learning management is learner-centered learning management that enables learners to choose what they want to learn on their own. Problems are set as the starting point of learning and as a motivator for students to develop critical thinking skills. Synthesize and solve problems. The process of managing such learning consists of 5 stages (ONEC, 2007).

For that reason, this research aimed to develop learning management activities by applying problem-based learning and to develop analytical thinking in science and technology courses for grade 9 Students. Provide students with analytical thinking following the criteria set by the school by applying problem-based learning. It also guides the promotion of effective science learning and the further development of science learning management.

METODE

Research Methodology

This research is a form of Developmental Research model Type I (Richey and Klein, 2007). There are two phases of the design and development of innovations: the Development Process and the Evaluation Process. This research is Phase 2, The Development of learning management activities by applying problem-based learning shows the following details.

Phase 1: Development Process

1. Study the current state of learning management problems and the need to organize learning management activities and develop activities by applying problem-based learning.
2. Design learning management activities by applying problem-based learning.

Use the information from the study of learning analytical thinking problems to create a learning management plan and the tools used to collect data. After that, It will be examined by 3 experts.

3. Try out a learning management plan of 5 with an experimental group, graders 9/2 Semester 1 Academic Year 2022, 23 persons in a school in Kalasin province. Thailand. It was acquired by selecting a model of Purposive Sampling. Using analytical thinking tests. Moreover, a satisfaction questionnaire was used to collect data.

Phase 2: Evaluation Process

Organize learning activities by applying problem-based learning total of 5 plans with graders 9/1, after using the analytical thinking test with the sample group of students, including having students take a satisfaction assessment questionnaire for learning management by applying problem-based learning.

Samples Group

Phase 1: The sample group research is divided into 2 groups: A group of 3 experts as follows: A content Expert 1 person, a Pedagogical expert 1 person, and a Measurement and Evaluation Specialist 1 person. Moreover, a group of students, namely 23 students in grade 9/2 student of the academic year 2022, were selected as purposive sampling.

Phase 2: The sample group of 23 students in grade 9/1 student, semester 1/ 2022, was selected as purposive sampling because the sample group did not pass the analytical thinking assessment by testing analytical thinking at the criteria of 70%.

Research Tools

The tools used in this experiment were:

1. Learning management plan by applying problem-based learning on materials in everyday life, totaling 5 plans. The total learning management time is 11 hours through finding the suitability.
2. Analytical thinking test Multiple-choice form, 4 options, 30 items. Through the determination of IOC (Index of consistency) and discriminant power. (Rovinelli and Hambleton, 1997)
3. Satisfaction questionnaire, 10 items, 5 level estimation scale. Passed the assessment IOC (Index of consistency) determination.

Data Collection

In this research. The researcher has tried and collected data. The procedure for collecting data is as follows:

1. Use analytical thinking test for graders 9 students and the sample group of students.
2. Organize learning management activities with the sample group of students by applying problem-based learning according to the learning management plan 1-5, complete 5 plans in 11 hours, and collect points after class.
3. Organize learning management activities with the sample group of students By applying the problem-based learning according to the learning management plan 1-5, completing 5 plans in 11 hours, collecting points after the lesson, and answering the satisfaction questionnaire.

Data Analysis

1. Finding the appropriateness of the learning management plan by using the mean, then the average result is translated into the rating scale 5 levels (Hemphill and Westie, 1950) as follows:

- 4.51 - 5.00 Appropriateness at the highest level
- 3.51 - 4.50 High level of suitability
- 2.51 - 3.50 Moderate suitability
- 1.51 - 2.50 Low level of suitability

1.00 - 1.50 Lowest level of suitability

2. Analyze the data from the analytical thinking test obtained from the test after the end of the learning activities by finding the Mean, Percentage, and standard deviation. If the learner gets 70%, pass the criterion, and if it gets less than 70%, does not pass the criterion.

3. Student satisfaction scores are taken as the mean. And the standard deviation, Take the mean to find the satisfaction level 5 levels (Rovinelli and Hambleton, 1997) as follows:

- 5 most satisfied
- 4 very satisfied
- 3 moderately satisfied
- 2 less satisfied
- 1 least satisfied

RESULTS AND DISCUSSION

Develop Learning Management Activities by Applying Problem-Based Learning for Grade 9 Students in Science And Technology Subjects, Meeting the 70/70 Criteria.

The results of the analysis of learning management activities by applying problem-based learning. Appears in Table 1.

Table 1. Synthesis of learning management style

5E Model Learning Management (IPST, 2005)	problem-based learning management (ONEC, 2007)	Learning management applied problem-based learning (Re-Searcher)	Differences in learning management	teacher role
Step 1: Engagement Generate interest: Importing into lessons or scraps may start from the students' interest.	Step 1: Identify the problem: Create scenarios to arouse interest and see the problem.	Step 1: Identify the problem and understand it: Create problems to arouse interest and see the problem, which must understand the problem that arises.	Learning management by applying problems as a base Step 2 Join in Step 1.	Coach, Facilitator
Step 2: Exploration: Understanding the issues studied and searching for knowledge.	Step 2: Understand the problem: Understand the problem that needs to be learned. Who must be able to explain things related to the problem?	Step 2: Make a study plan: Plan to conduct self-study with a variety of methods.		Coach
Step 3: Explanation: Explain and summarize. Conclusions analysing	Step 3: Conduct research studies: Determine what to study, conduct studies, and research	Step 3: Synthesize knowledge: Synthesis of the acquired knowledge is used to determine		Coach, Co-learner

5E Model Learning Management (IPST, 2005)	problem-based learning management (ONEC, 2007)	Learning management applied problem-based learning (Re-Searcher)	Differences in learning management	teacher role
interpreting, and summarizing the results obtained.	with various methods.	whether knowledge is appropriate or not.		
Step 4: Expand knowledge: Bringing the knowledge created to link with the previous knowledge.	Step 4: Synthesize knowledge: Bring the knowledge that has been researched to exchange, learn together, and discuss	Step 4: Summarize and evaluate the answer: Summarize the knowledge that has been exchanged and learned together. And evaluate whether the information studied and researched is appropriate or not.		Coach, Co-learner
Step 5: Evaluation: Evaluation of learning from the activities studied.	Step 5: Summarize and evaluate the answer: Each group summarized their work. And evaluate the work.		Problem-based learning management emphasizes getting students to practice. And have practiced analytical thinking on their own	
	Step 6: Present and evaluate the work: Bring the acquired knowledge to organize			

From Table 1. learning management the quest for knowledge (5E) model is a learning management that generates interest for students to understand what they want to learn by searching for answers. And it can explain the knowledge for themselves. But due to learning management, the quest for knowledge (5E) model may not yet be able to develop all the abilities and skills of the students. Management learns by applying problem-based learning. We studied management styles and learned problem-based learning (ONEC, 2007) There are 6 steps to the process: Step 1: Identify the problem, Step 2: Understand the problem, Step 3: Conduct research studies, Step 4: Synthesize knowledge, Step 5: Summarize and evaluate the answer, and Step

6: Present and evaluate the work. Therefore, the researchers developed learning management activities by applying problem-based patterns, including step 1: setting up problems and understanding. Step 2: planning studies. Step 3: synthesizing knowledge. Moreover, step 4: summarizes and evaluates the answers. This is a learning arrangement that focuses on students practicing critical thinking. Plan your work and act on your own. (Pagander and Read, 2014) It also encourages students' interest in the class, making the class a fun-filled atmosphere. This results in learning management by applying problem-based learning. For graders 9 students, the efficiency is 72.12/70.76.

Results of Developing Analytical Thinking for Graders 9 Students Pass the Criteria of 70%.

The results of the analytical development analysis for graders 9 are shown in Table 2.

Table 2 Analytical thinking development After using learning activities by applying problem-based learning.

Analytical thinking skills	Full score	Phase 1			Phase 2		
		Average	Standard deviation	Percentage	Average	Standard deviation	Percentage
Importance	10	6.04	1.61	60.43	7.23	1.40	72.30
Relationship	10	5.87	1.29	58.70	7.14	1.28	71.36
Principle	10	5.57	1.24	55.65	7.09	1.27	70.91
Total	30	5.83	0.24	58.26	7.15	0.07	71.51

From Table 2. It found that the results of developing analytical thinking for graders 9 students. The latter uses learning activities by applying problem-based learning. Have an average score 1) Importance the average score was 7.23, representing 72.30%. 2) Relationship aspects, the average score was 7.14, representing 71.34%. 3) Principles, the average score was 7.09, representing 70.91%. It shows that the latter uses learning activities by applying problem-based learning. Students had analytical thinking total score of 7.15, representing 71.15%, passing the required 70% threshold.

The Results of the Analysis of Satisfaction with Learning Management by Applying Problem-Based Learning for Graders 9 Students in Science And Technology Subjects.

The results of the satisfaction analysis on learning management by applying problem-based learning. Appears in Table 3.

Table 3 The results of analytical thinking on the satisfaction of learning management by applying problem-based learning.

Item	Average	Standard deviation	level of satisfaction
learning atmosphere			
1. Students are free to study, research and exchange ideas.	4.82	0.49	Excellent

Item	Average	Standard deviation	level of satisfaction
2. Teachers give students opportunities to do activities freely.	4.73	0.62	Excellent
3. Students have opportunities to actually practice.	4.68	0.63	Excellent
Total	4.74	0.07	Excellent
learning activities			
1. Students participate fully in activities.	4.86	0.34	Excellent
2. Help students gain knowledge and understanding by themselves.	4.68	0.63	Excellent
3. Encourage students to study and find knowledge by themselves.	4.73	0.62	Excellent
4. Encourage students to think critically using the problem as a basis.	4.77	0.60	Excellent
Total	4.76	0.08	Excellent
Benefits			
1. Students understand the content and can remember the content for a long time.	4.73	0.54	Excellent
2. Help students work in a systematic way according to the workflow	4.64	0.77	Excellent
3. Help students think more critically.	4.77	0.60	Excellent
Total	4.71	0.07	Excellent
average including all 3 aspects	4.74	0.02	Excellent

From Table 3. It was found that graders 9 students were satisfied with learning management by applying problem-based learning to develop analytical thinking. In total, 3 aspects are at the highest level. The average score on all 3 sides was 4.74. When considering the side items sorted by a descending average score, namely: In terms of learning activities, the average score was 4.76. Regarding the learning atmosphere, the average score was 4.74, and the benefits side had an average score of 4.71.

The researcher summarized the research according to the objectives of the research, divided into 3 items as follows.

The results of the Develop learning management activities by applying problem-based learning for graders 9 students in science and technology subjects, meeting the 70/70 criteria. The researchers created There are 5 plans, 2-hour plans, and a learning management model applied using problem-based learning. It consists of 4 steps: Step 1: Set up problems and understand them, using students' everyday problems as a pique of interest and making it easier for students to understand the problem. Step 2: Study Planning provides an opportunity for students to plan their studies using a variety of methods. Step 3: Synthesize knowledge by using the acquired knowledge to determine whether it is accurate or not. Step 4: Summarizing and evaluating the value of the answers is to exchange the acquired knowledge and draw

conclusions while evaluating whether the results of the researched data are accurate or not. The learning management plan by applying problem-based learning has been reviewed by 3 experts. It was found that the management plan learns by applying problem-based learning. It is appropriate at the highest level. The average expert opinion score was 4.51. When experimenting to determine the effectiveness of the learning management model, it was found that the effectiveness of developing learning management activities by applying problem-based learning. Process efficiency (E_1) accounted for 72.12%, and outcome efficiency (E_2) was 70.76%. This may be because the learning management plan, based on the problem model, is a learning management that allows learners to independently choose what they are interested in, using the problem as a motivator for the learner to learn and be able to think critically and discern on their own, with teachers on hand to provide appropriate guidance. It also helps students learn and become interested in activities, allowing them to interact with teachers and friends. In the classroom, In accordance with (Touchathorn, 2017). It has guided learning management activities using problem-based learning management holes. Step 1: Determine the problem Step 2: Understand the problem, Step 3: Conduct a research study, Step 4: synthesize knowledge, step 5: summarize and evaluate the value of the answers, step 6: present and evaluate the work. and in accordance with (DOUNGWILAI, 2018). It has studied the development of analytical thinking skills of graders 9 students by managing problem-based learning. It was found that the learning management plan develops analytical thinking skills. It has an efficiency of 86.61/82.80.

The results of the development of analytical thinking of graders 9 students to pass the 70% threshold. By applying problem-based learning management. Material matters in everyday life subject. It has been found that problem-based learning can develop analytical thinking. Each student so there is an analytical thinking score higher than the specified threshold, which is 70%. This may be due to the management of learning by applying problem-based learning. It focuses on the learner and allows the learner to choose what they want to learn on their own, with the problem itself as the starting point of learning and as a motivator, giving the learner the skills to think critically in all 3 areas, namely: Significance, Relationship aspects, and principles. This is consistent with Bloom's theory of learning procedures (Bloom, 1956). In other words, critical thinking is the ability to discern what subsets of events, stories, or content are made up of. What's the significance, what's causing What is the result, and what principle is that? And analytical thinking can be developed by applying problem-based learning management since learners are motivated to think critically. (Noor et al., 2019). Following (Mantruat et al., 2019). Have studied the development of analytical thinking skills. In science and technology courses, using a problem-based learning management model for grade 8

students. It was found that developing analytical thinking skills after using problem-based learning. Students had higher analytical thinking skills, accounting for 84.78%, which met the 70% threshold.

The results of study satisfaction with learning management by applying problem-based learning. For graders 9 students in science and technology courses in this research, In total, 3 aspects are at the highest level. The average score on all 3 sides was 4.74. When considering the side items sorted by a descending average score, namely: In terms of learning activities, the average score was 4.76. Regarding the learning atmosphere, The average score was 4.74, and the benefits side had an average score of 4.71. This may be because the learning management activities are problem-based learning that emphasizes students' practice of analytical thinking. Plan your work and act independently on your own. As a result, students' interest in learning makes the classroom atmosphere fun, with teachers on hand to guide them. Moreover, encourage students to study by allowing all students to talk, exchange knowledge and ideas, and learn new learning styles. Moreover, a variety of contents cause a state of positive emotions. Corresponds to (Touchathorn, 2017). Using Problem-Based Learning to Support the analytical Thinking in Science Subject of Matthayomsuksa1 Students Research has shown that reliance on problem-solving is a base for promoting analytical thinking among students. The average score of 4.27 overall is very satisfactory.

CONCLUSION

Development of learning management activities by applying problem-based learning to develop analytical thinking in science and technology courses; there are 4 steps as follows: Step 1: Set up the problem and understand it, Step 2: Plan your studies and research, Step 3: synthesizes knowledge, and Step 4: summarizes and evaluates the value of the answers. 5 learning management plans passed the evaluation from 3 experts. Assessment results that are the most suitable have an overall average score of 4.51. Moreover, there is the effectiveness of learning management by applying problem-based learning has process efficiency (E_1) accounting for 72.12%, and outcome efficiency (E_2) was 70.76%. Higher than the specified threshold.

The results of analytical thinking development for students in grades 9 are as follows: 1) Importance the average score was 7.23, representing 72.30%. 2) Relationship aspects, the average score was 7.14, representing 71.34%. 3) Principles, the average score was 7.09, representing 70.91%. It shows that the latter uses learning activities by applying problem-based learning. Students had analytical thinking total score of 7.15, representing 71.15%, passing the required 70% threshold. Moreover, the results of the study of students' satisfaction with learning

management by applying problem-based learning. Overall, the average score in all three areas was 4.74. That is the most satisfying level.

Suggestions for Applying the Research Results

Organizing learning management activities by applying problem-based patterns. It is worth considering the appropriateness of the content used in learning management activities. Moreover, activities are used to fit the number of hours in the learning management plan.

Suggestions For Further Research

Other forms of learning management activities should be studied. To develop analytical thinking and apply it to students in science learning groups or other learning subject groups as appropriate.

ACKNOWLEDGEMENT

The researchers thank the experts for taking the time to review the shortcomings of the lesson plan and review the correctness of the analytical thinking exam. To determine the contextual consistency of the tools used in the research. Moreover, thank the director, the faculty, administrators, faculty, and students have been well-informed in conducting the research.

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