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Development of Scientific Thinking for 4th Grade Students Based on Predict-Observe-Present-Explain (POPE) Activity Management

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Abstract

Scientific thinking is considered to be an important factor influenced the scientific learning achievements and the goal of providing the thinking skills. Therefore, the purpose of this research was attempted to develop the scientific thinking for 4th Grade students using Predict-Observe-Present-Explain (POPE) activity management to achieve the 70% criteria. The target group was 6 students of 4th Grade students at a primary school, Ban Don Santi School, Maha Sarakham Province, Northeastern Thailand. The participants chosen by the purposive sampling was studying in the second semester of the academic year 2021. The

research instruments were 1) the twelve lesson plans for Predict-Observe-Present-Explain (POPE) activity, 2) the multiple choices test for the scientific thinking and 3) the observation form of scientific thinking. Data were analyzed and expressed as mean, percentage and standard deviation. The findings demonstrate that the percentage score of students' scientific thinking was 65% for the first learning cycle and 79.45% for the second learning cycle that using the developed POPE activity

The obtained results from this research indicate that predict-observe-present-explain (POPE) activity management is a learning strategy that can be used for developing the scientific thinking to achieve the 70% of the scientific thinking criteria and applied for developing other scientific performances.

Keywords: Predict-Observe-Present-Explain (POPE) learning strategy, Scientific thinking

1. Introduction

1.1 Importance of Scientific Thinking

It is well recognized that science plays an important role and has an enormous influence on human beings. The world society today dramatically changes due to the revolution in information technology and the rapid disseminate of knowledge and science. Science also play a key role in creating a body of knowledge, developing technology and innovation related to the daily life of human beings and human resources in terms of knowledge, thinking process, and working skills. In addition, it assists humans to develop creative thinking and critical thinking which are all advanced skills, and to have essential skills in both scientific process skills and the 21st century skills in researching and building the knowledge through the process of seeking knowledge (Panit, 2012). For human resource development, the learning management that encourages the students to be the enthusiastic scientific learning persons is essential to be developed. The science teaching must be focused on both content and scientific thinking to achieve the goal of providing students with thinking skills. Moreover, students must be provided with the opportunity to express their opinions in analytical, scientific, critical, and problem-solving thinking as Susaorat (2013) who stated that thinking skill is necessary for individual quality, including physical, emotional, social and intellectual aspects, which is an important basis for the country's development.

Scientific thinking is a type of thinking to gain knowledge using and supporting the scientific method (Jarwan, 2005). It is a mental activity that is necessary in regulation the individual ideas and solving problems, and helps the individuals to make the decisions (Qadri, 2005). And also, Zaitoon (2014) mentions to scientific thinking as that mental activity used by the individual to address the problems confronted, search and explore problems, and find the solutions. Thus, it is normally employed to prove and explore the facts. Scientific knowledge and methods are to plan, examine and explain by the scientific process, including asking questions, making observations, forming a hypothesis, doing a prediction, testing, and concluding (Institute for the Promotion of Teaching Science and Technology, 2008). The promotion of scientific thinking among students and train them to solve problems is one aspect of the education development and educational reform movement that has cast a

shadow on the various fields of education and education system (Zaitoon, 2014). The scientific thinking is able to comprehend events or phenomena in daily life by relying on knowledge and scientific methods (Pattawaro, 2017). Due to the scientific thinking is a thinking process of searching for answering based on the scientific principles and reasons with empirical evidence to support the reason from scientific process skills, leading to the solution, and the one having a scientific thinking and basic knowledge of science can make effective decision (The Office of the National Education Commission, 2010), thus individual with scientific thinking will be able to solve the problems in daily life or work rationally. Nevertheless, the use of constructivist learning model in the teaching of science can contribute to the improvement of student achievement, and the development of their scientific thinking as well (Qarareh, 2016).

1.2 Identifying the Problem

Ban Don Santi School is a primary school in Kosum Phisai District, Maha Sarakham Province, northeast of Thailand. There are a total of 139 students in this school. In this school, the development of education both curriculum and learning activities have continuously been conducted. The development of curriculum is focused on student center. Learning activities provided for students are to develop the students's thinking skills, including analytical thinking, creative thinking, and scientific thinking (Ban Don Santi School, 2020). Unfortunately, most of the teachers who give a lecture for the lower level students have not been experienced in science teaching. And also, the provided lecturing does not focus on practice, resulting in the students' scientific learning experience that does not lead to scientific thinking. According to the goal of science teaching of the Ministry of Education (2008) is to assist the students to achieve the knowledge themselves as much as possible by providing the learning activities that encourage the students to develop their rationality, creative and critical scientific thinking, and have imperative skills in both scientific process skills and the 21st century skills in searching and building the knowledge through the process of searching the knowledge, being able to solve the problems systematically and making a decision based on the data and verifiable evidence. This will enable the students to develop scientific process skills. As lesson plan is one of the important factors influenced the students' achievement with higher learning efficiency, hence the lesson plans along with the innovations or techniques using in learning management that provide the students' systematic scientific thinking and essential skills to obtain the knowledge, according to the goals of the Ministry of Education and the schools' administration, are necessary to be developed.

1.3 Concept, Theory and POPE Related

Prediction-Observation-Present-Explain (POPE) learning activity is focused on the students to build their own body of knowledge, and is a guideline for the learning management that assists students not only to gain knowledge and understanding of science but also to develop scientific process skills along with scientific thinking, resulting in the development of learning potential. The POPE learning activity has been developed from Gunstone and Mitchell's (2005) POE (Predict-Observe-Explain) learning activity by adding one more step,

which is Present: P to allow students to show their ability to present the information, discuss and reflect on scientific principles. The presentation allows the students to use all five senses to collect the data details from observations and do the experiments to present the information and compare the similarities or differences of the information (Bergere & Boelryk, 2005). This can foster scientific thinking due to the students can learn by doing. The POPE learning activity consists of 4 steps. The first step is Predict (P) to predict the outcome of a problem or the experimental results obtained. The second step is Observe (O) to find answers by testing, observing, doing activities, searching for information and other performing to solve the problems. The third step is Present (P) to present the findings from observation, doing experiment, searching for information, including questioning, hypothesis testing, interpretation, and conclusions based on scientific evidence to demonstrate scientific thinking. The fourth step is Explain (E) to explain and conclude the body of knowledge based on scientific principles from the step of Predict and the findings obtained to verify the consistency, accuracy and precision. Therefore, POPE is an effective process to encourage students to express their opinions and discuss scientific concepts, changing ideas and beliefs which what is to be learned and also the learning activity that helps students to better comprehend the lesson, resulting in a positive effect on learning as they experience it by themselves (Gunstone, 1992; Gunstone, 2013). Actually, the new knowledge can be obtained from the learning experience by doing experiment or searching information to develop a new understanding.

Base on the context above and to see whether utilization of the POPE learning activity in the learning management can encourage and facilitate students to express their opinions, discuss the proven scientific concept, practice thinking skills to solve the problems and also develop scientific thinking skills, this research was therefore carried out to develop the scientific thinking for 4th students by using Predict-Observe-Present-Explain (POPE) learning activity to achieve the 70% scientific thinking criteria that would lead to be an effective science learning management.

2. Materials and Methods

2.1 Participants

Six students (5 boys and 1 girl) of 4th Grade student, studying in the second semester of the academic year 2021 at Ban Don Santi School, Maha Sarakham Province, Thailand were subjected to this research. These students were purposive chosen due to their learning achievements were not get through the 70% criteria of scientific thinking tests according to Pattawaro (2017) as shown in Table 1.

Table 1. Score and percentage of Scientific Thinking of the students participated in this research

Student	Scientific Thinking Score	
	Total score (30)	Percentages (%)
1	16	53.33
2	17	56.67
3	18	60.00
4	18	60.00
5	20	66.67
6	19	63.33
Mean	18	60.00

Source: Pattawaro (2017) Development of Learning Achievement and Scientific Thinking of Prathomsuksa 5 by the 5 Es of Inquiry-Based Learning Promoting Scientific Thinking Processes. M.Ed. Thesis in Curriculum and Instruction, Faculty of Education, Mahasarakham University.

2.2 Research Instrument

2.2.1 The 12 Predict-Observe-Present-Explain (POPE) lesson plans of a science course: Material and Matter for the 4th Grade students. The 1st-6th lesson plans were performed for the first learning cycle, meanwhile the 7th-12th lesson plans for the second learning cycle. A 6-week scientific thinking instruction based on POPE strategy was conducted for six weeks.

2.2.2 The 30 items of multiple choices tests of the scientific thinking were used at the end of each learning cycle for the comprehensive assessment of students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing and thinking for interpretation.

2.2.3 The observation checklist forms for the assessment of students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing and thinking for interpretation were assessed during the POPE learning activities.

2.4 Research Procedure and Data Collection

The research was conducted according to the concept of Kemmis and McTaggart (1988) by using PAOR framework as a starting point for action research as depicted in Figure 1. Two learning cycles were employed. Each cycle consists of 4 steps: 1) Planning, 2) Action, 3) Observation and 4) Reflection.

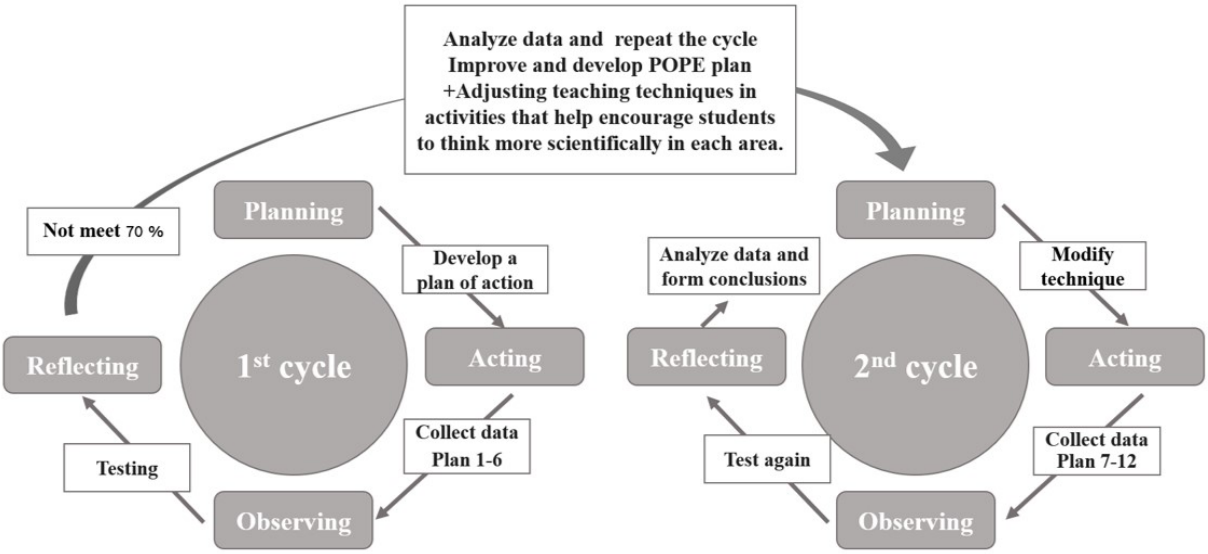

Figure 1. Conceptual framework of this research

This action research was conducted as follows:

2.4.1 First Learning Cycle

(1) Planning

Searching the papers related to scientific thinking to find a development guideline used to create the instruments for data collection, including the lesson plans of Predict-Observe-Present-Explain (POPE) learning activity on a science course: Materials and Matter (12 lesson plans/12 hours), 30 items of the 4 multiple choices of scientific thinking tests, and 8 items of observation checklist forms for the scientific thinking behavior observation

(2) Learning

Organize learning activities based on discussion on the problems and/or other obstacles found in the learning activities on the 1st-6th lesson plans

(3) Observation

Observing the students' scientific thinking both during the POPE learning activities by using the observation checklist for each plan of learning activity and at the end of the first learning cycle by using the 30 items of the 4 multiple choices of scientific thinking test.

(4) Reflection

Analyzing the mean score and percentage score of students' scientific thinking of scientific thinking test and also scientific thinking observation, just in case of the students' scientific thinking was not achieved the criteria, the second learning cycle using the POPE learning activity on the 7th-12th lesson plans be further conducted in order to provide the better

students' scientific thinking.

2.4.2 Second Learning Cycle

(1) Planning

Applying the obtained results from the analysis and conclusion of scientific thinking of the first learning cycle to plan and improve, and along with the addition of the techniques in teaching activities to encourage the students to have more scientific thinking in all the aspects in the second learning cycle

(2) Learning

Organizing learning activity was conducted with the same pattern as in the first learning cycle but the 7^{th}-12^{th} lesson plans was employed.

(3) Observation

Observing the students' scientific thinking in the second learning cycle performed in line with that in the first learning cycle.

(4) Reflection

Analyzing the data from the scientific thinking test and scientific thinking observation checklist in each aspect, and comparing with the 70% criteria

2.5 Data Analysis

The data obtained in this research were analyzed using the basic statistics, and expressed as percentage, mean and standard deviation.

3. Results

3.1 First Learning Cycle

Table 2 shows the score and percentage of the students' scientific thinking from using the scientific thinking multiple choices tests to comprehensive assess of 4 aspects of students' scientific thinking after the first learning cycle through the POPE learning activity on the 1^{st}-6^{th} lesson plans. The score and percentage of scientific thinking of the students, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation and conclusion ranged from 60 to 73.33% which was 18 scores or 60% for the first student, 19 scores or 63.33% for the second student, 20 scores or 66.67% for the third student, 18 scores or 60% for the fourth student, 22 scores or 73.33% for the fifth student, and 20 scores or 66.67% for the sixth student. The mean score, and percentage score of 4 aspects of students' scientific thinking after the first learning cycle through the POPE learning activity was 19.50, 65%, respectively. Unfortunately, only one student achieved the specify criteria with the percentage score of 73.33%.

Table 2. Total score and percentage score of students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation using the scientific thinking test after the first learning cycle through the POPE learning activity on the 1st-6th lesson plans

Student	Scientific Thinking Score					
	Thinking for Questioning (7)	Thinking for Hypothesizing (11)	Thinking for Hypothesis Testing (2)	Thinking for Interpretation and Conclusion (10)	Total score (30)	Percentage (%)
1	5	6	1	6	18	60.00
2	5	6	1	7	19	63.33
3	6	7	1	6	20	66.67
4	5	6	0	7	18	60.00
5	7	7	2	6	22	73.33
6	5	7	2	6	20	66.67
Mean	5.50	6.50	1.17	6.33	19.50	65.00
Standard Deviation	0.84	0.55	0.75	0.52	1.52	5.05

Table 3 shows the scientific thinking of the students, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation assessed by using the scientific thinking behavior observation checklist during the POPE learning activities in the first learning cycle. The results revealed that scientific thinking of the students did not meet the achievement of the scientific thinking criteria. Most of the students could not show to have some aspects of the scientific thinking. Surprisingly, one of the students has been found to have all the specify aspects of the scientific thinking. In addition, all of the students showed to have the thinking for questioning as they could make a question and identify or specify the problems occurred in that situation.

Table 3. Students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation and conclusion assessed by using scientific thinking observation checklist during POPE learning activities in the first learning cycle

Item		Student					
		1	2	3	4	5	6
Thinking for Questioning	Students can form a question or identify the problems occurred in that situation.	✓	✓	✓	✓	✓	✓
	Students can determine the information from that situation or experiments to specify the cause of the problems based on scientific reasoning.	✓	✓	✓	×	✓	✓
Thinking for Hypothesizing	Students can predict the outcome answers from several situations	×	✓	×	✓	✓	✓
	Students can give the reason based on the principles, theories and facts for hypothesizing.	✓	✓	✓	×	✓	✓
Thinking for Hypothesis Testing	Students can plan or find a method for the hypothesis testing.	×	×	✓	×	✓	✓
	Students can conduct the experiments or use the methods to test the hypothesis correctly.	✓	×	✓	✓	✓	✓
Thinking for Interpretation and Conclusion	Students can analyze and interpret the data or the results of the experiment based on the principle and scientific reasons for explanation.	✓	✓	✓	✓	✓	×
	Students can use the scientific principles to conclude the body of knowledge correctly.	✓	✓	✓	×	✓	✓

Note. ✓ is referred to pass and × is referred to do not pass.

3.2 The Second Learning Cycle

According to the scientific thinking of students in the first learning cycle using the POPE learning activity did not meet the 70% criteria (Table 2), therefore the POPE learning activity was improved, developed and used in the second learning cycle for providing the students' scientific thinking to be achieved the criteria.

Utilization of the scientific thinking multiple choices tests to comprehensive assess of students' scientific thinking after the second learning cycle using the POPE learning activity on the 7^{th}-12^{th} lesson plans revealed that the mean score and percentage score of students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation and conclusion was 22 scores or

73.33% for the first student, 23 scores or 76.67% for the second student, 25 scores or 83.33% for the third student, 23 scores or 76.67% for the fourth student, 26 scores or 86.67% for the fifth student, and 24 scores or 80% for the sixth student. The mean total score and mean percentage score of all students was 23.83 and 79.45%, respectively. The percentage score of scientific thinking of all students ranged from 73.33 to 86.67%, which was found to achieve the 70% of scientific thinking criteria as presented in Table 4.

Table 4. Total score and percentage score of the students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation and conclusion assessed by using scientific thinking test after the second learning cycle through the POPE learning activity on the 7th-12th lesson plans

Student	Scientific Thinking Score					
	Thinking for Questioning (7)	Thinking for Hypothesizing (11)	Thinking for Hypothesis Testing (2)	Thinking for Interpretation and Conclusion (10)	Total score (30)	Percentages (%)
1	6	7	2	7	22	73.33
2	6	8	1	8	23	76.67
3	7	8	2	8	25	83.33
4	6	7	2	8	23	76.67
5	7	10	2	7	26	86.67
6	7	8	2	7	24	80.00
Mean	6.50	8.00	1.83	7.50	23.83	79.45
Standard Deviation	0.55	1.10	0.41	0.55	1.47	4.91

Table 5 shows the students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation assessed by using the scientific thinking behavior observation checklist during the second learning cycle through the POPE learning activities on the 7th-12th lesson plans which revealed that, apart from an aspect of students can plan or find a method for the hypothesis testing of only one student, all the students showed to have all the aspects of the scientific thinking. In addition, the students used more scientific principles for explanation compared with that used in the first learning cycle. The students also paid more attention to study and listen to the teacher carefully about the lesson and the steps in the activities, could comprehend the lesson, and do the activities correctly. Furthermore, the students could present the own ideas based on the scientific principles to explain the rationale in thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation and conclusion based on the scientific principles. This indicates the development of students' scientific

thinking. This result was confirmed by the scientific thinking scores from the scientific thinking test after the second learning cycle that showed the mean percentage score higher than the desired criteria, with the exception of the thinking for hypothesis testing that the students can plan or find a method for the hypothesis testing and the thinking for interpretation and conclusion that the students can use to conclude the body of knowledge correctly.

Table 5. Students' scientific thinking, including thinking for questioning, thinking for hypothesizing, thinking for hypothesis testing, and thinking for interpretation and conclusion assessed by using scientific thinking observation checklist during POPE learning activities in the second learning cycle

Item		**Student**					
		1	**2**	**3**	**4**	**5**	**6**
Thinking for Questioning	Students can form a question or identify the problems occurred in that situation.	✓	✓	✓	✓	✓	✓
	Students can determine the information from that situation or experiments to specify the cause of the problems based on scientific reasoning.	✓	✓	✓	✓	✓	✓
Thinking for Hypothesizing	Students can predict the outcome answers from several situations	✓	✓	✓	✓	✓	✓
	Students can give the reason based on the principles, theories and facts for hypothesizing.	✓	✓	✓	✓	✓	✓
Thinking for Hypothesis Testing	Students can plan or find a method for the hypothesis testing.	×	✓	✓	✓	✓	✓
	Students can conduct the experiments or use the methods to test the hypothesis correctly.	✓	✓	✓	✓	✓	✓
Thinking for Interpretation and Conclusion	Students can analyze and interpret the data or the results of the experiment based on the principle and scientific reasons for explanation.	✓	✓	✓	✓	✓	✓
	Students can use the scientific principles to conclude the body of knowledge correctly.	✓	✓	✓	×	✓	✓

Note. ✓ is referred to pass and × is referred to do not pass.

In comparison, the scientific thinking in each aspect, mean score and percentage score of the scientific thinking of the students in the second learning cycle using the POPE learning activity on the 7th-12th lesson plans was found to be higher than that in the first learning cycle

using the POPE learning activity on the 1st-6th lesson plans as presented in Figure 2 and 3.

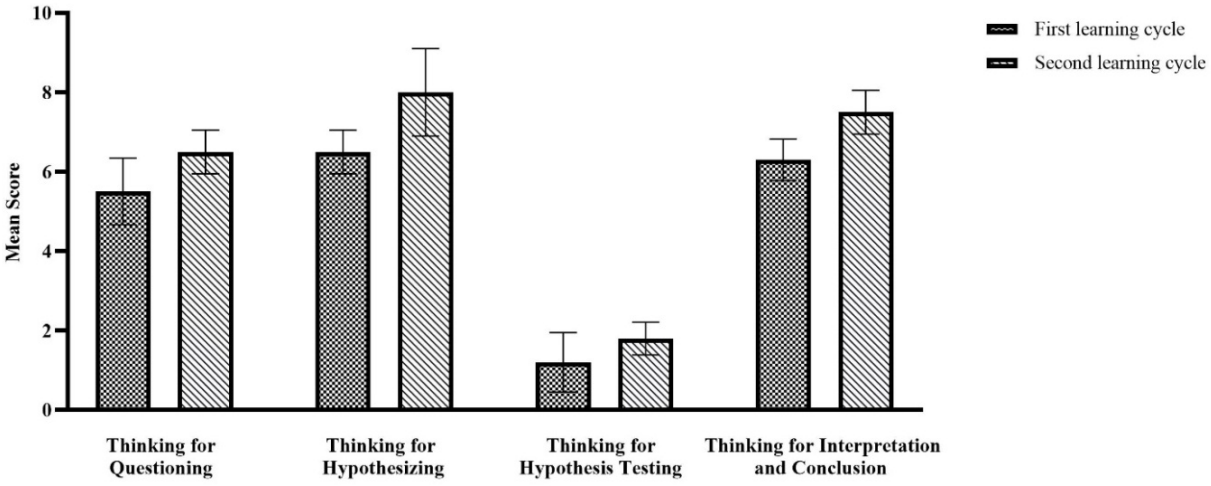

Figure 2. Scientific thinking of the students on the aspects of thinking for questioning, thinking for hypothesizing, thinking for hypothesize testing, and thinking for interpretation and conclusion in the first and second learning cycle using POPE learning activity

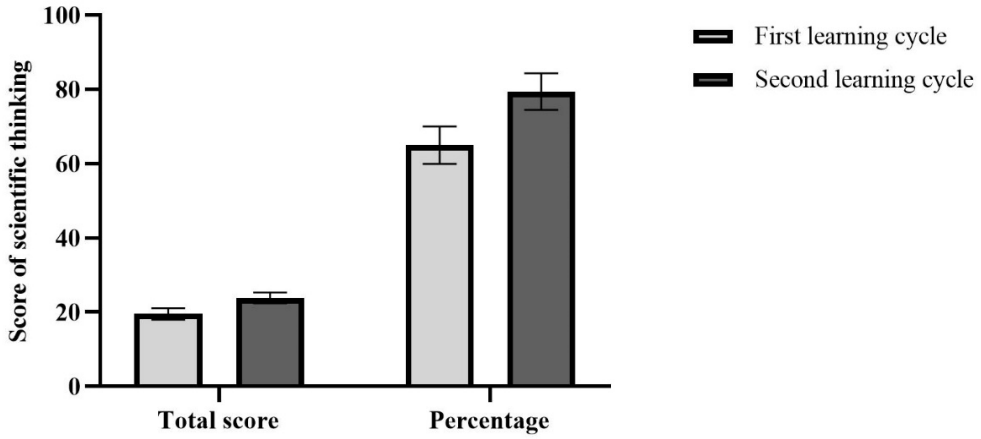

Figure 3. Mean score and percentage score of the students' scientific thinking in the first and second learning cycle using POPE learning activity

4. Discussion

According to the results obtained from the learning using the Predict-Observe-Present-Explain (POPE) learning activity, the scientific thinking of students in the first learning did not meet the 70% of criteria. It was found that most of the students lacked of the ability to think for hypothesis testing, could not plan or find a method or process for hypothesizing and hypothesis testing and did it incorrectly as well. Moreover, in some activities the students could not rationalize by using the principles or facts. In addition, the students did not

understand the lesson or principles used in the activities in the scientific process and also could not explain the reason by using scientific principles due to they did not pay attention to listen to the explanation given by the teacher. Surprisingly, the scientific thinking of students in the second learning cycle (Table 4 and Figure 3) was found to be met the 70% of scientific thinking criteria and higher than that in the first learning cycle (Table 2 and Figure 3). Increasing students' scientific thinking is more likely due to the ongoing POPE learning activity improved and developed by the researchers that provides the appropriate phenomena and performances as follows;

4.1 Step 1: Predict

The teacher stimulates the students' interested in the learning by asking some questions and creating a situation or issue that encourage the students to answer or predict the results based on the scientific principles. Some learning activities, the educational media, such as pictures or technological devices and questions related to the lesson plans or daily life are administered so that the students are interested in the activities, find the answers, and think together to solve the problems and hypothesis based on scientific principles.

4.2 Step 2: Observe

The students are required to observe, do the experiment, research for information and methods to solve the problems. To do that, the students can conduct the experiment by themselves and together with others to think and consider the issues in the experimental process based on scientific principles, including questioning, hypothesizing, hypothesis testing, interpreting, and concluding along with the teacher's guideline and organized experiment. As some learning activity has no experiments, therefore, the students can practice the scientific process in each step which is a contributing part of scientific thinking.

4.3 Step 3: Present

This step is added by the researcher, the students present the results of their own activities, including questioning, hypothesizing, hypothesize testing, interpreting, and concluding. The students have to give the reasons, concepts, and scientific principles in each step to reflect scientific thinking. During the presentation, the students share knowledge among themselves. The students can practice presenting information from observations and experiments based on reasons so that students can reflect on their thinking in each step of the activity that enhance students' scientific thinking.

4.4 Step 4: Explain

The teacher together with the students explain and conclude the body of knowledge by the students play a key role in the action, meanwhile the teacher ask the questions and provide the additional advices to precisely conclude the experiments. The results are explained base on the scientific principles and reasons to support or contradict the prediction, resulting in the students achieve to gain a new body of knowledge based on prior knowledge and experience.

According to the students' scientific thinking obtained result from using the POPE learning activity assessed by the scientific thinking test in the second learning cycle was higher than

the specified criteria (70%). This is mainly due to the POPE learning activity focus on the students and provides the students' learning by doing on their own that leading to get higher students' new knowledge based on prior experience or old knowledge. Another word, the new knowledge is obtained from the actual learning experience from the experiment or several methods to the correct understanding. The result is in accordance with Thongchumnum (2004), stating that scientific thinking occurs when there is a problem that requires a clear answer. Asmoro and Prayitno (2021), stating that scientific thinking is the process of reviewing ideas using science, observations, investigational processes, and testing them to gain answer or explanation by relying on knowledge and the scientific process. The problems can be identified and hypothesized to predict answers as well as collecting data and conducting experiments to test that hypothesis along with a conclusion. The conclusion from scientific thinking is a result of a clear principle or answer. The present finding is also in line with the theory of constructivism that encourages students to make decisions about understandings based on prior knowledge and to focus on appropriately creating new knowledge for individuals (Chaicharoen, 2002; Shah, 2019). This due to constructivist learning can develop of scientific thinking by providing the students' opportunity to practice thinking skills to develop hypotheses and testing. It also gives the students' opportunity to debate and discuss with others, which helps to develop the students' scientific thinking skill (Qadri, 2005).

For the scientific method, there is a step in the presentation to train the students to use the five senses for data collecting from the observations and experiments to present and compare the collected data. This can foster scientific thinking due to the students can do learning by doing. Students' knowledge is achieved after the actually practicing on each step to enhance the scientific thinking. This is also in accordance with the Institute for the Promotion of Teaching Science and Technology (2012), reporting that the POE learning activity encourages students to ask questions and trigger interest with the intention to do the experiment. Students are required to predict the outcome before doing the activity. Students observe and bring the results to discuss what has been predicted. This makes it feel exciting and enthusiastic for students. Moreover, doing activities or experiments are a challenge in the searching for knowledge to probe their predictions. As a result, the students can think and create a body of knowledge by themselves.

In the present research, the step of Present (P) is added (POPE) in order to provide the students to give a presentation on their activities, including questioning, hypothesizing, hypothesize testing, interpreting, and concluding based on the scientific principles and scientific process. Therefore, the students can express their ideas, understand the lesson and principles, and also have higher scientific thinking. This is consistent with Bergere and Boelryk (2005), stating that the students can achieve scientific thinking by relying on scientific methods, scientific reasoning, and data analyses.

5. Conclusions

The scientific thinking of the students in the second learning cycle using POPE learning activity is met the achievement of 70% scientific thinking criteria and higher than that in the

first learning cycle. This is due to the POPE learning activity provides and facilitates the students to do the activities on their own leading to build a body of knowledge based on the scientific process that enhances students' scientific thinking. The students can practice on hypothesizing, testing the hypotheses, and interpreting and concluding the results base on the scientific processes. The 4th Grade students possess higher and efficient scientific thinking. Therefore, it can be concluded that the Predict-Observe-Present-Explain (POPE) learning activity is an efficient and appropriate learning management that can be used for developing the scientific thinking and applied for developing other scientific performances and education management.

As an appropriate time, learning management and encouragement from the teachers are found to be influenced the learning activities and students' scientific thinking. Further work, the development of lesson plans and teacher encouragement for learning activities and scientific thinking is needed.

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