

The Predictive-Observation-Explanatory (POE) Technology based Learning Management Results to Promote Scientific Explanations Making about the Change of the Substance for Primary School Students

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Abstract

The research aimed to 1) build and assess suitability of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students, 2) to distill the lesson learnt of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students. The research was action research. The sample in the research consisted of: (1) a group of experts assessing the learning management approach, namely staff of teachers, teachers of science and experts of science learning management, accounting for 9 people and (2) the experimental group of learning management, namely 3 science teacher and 40 Year 5 primary school students. Purposive sampling was used to come up with a total of 52 people. The study results revealed that:

1) Building and assessing suitability of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students has brought about the learning management plan for 3 learning management plans by using the total of 3 hours for learning. There is the process in organizing learning activities for 7 steps called “7P POE Technology based Learning Model” consisting of (1) Positive Stimulate, (2) Pre-debate, (3) Predict, (4) Post-debate, (5) Participant Observation, (6) Phenomenon Explanation and (7) Practice and the result of suitability assessment was at the highest level.

2) Distilling the lesson learned of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students has found that scientific learning competency called (Scientific Explanations Making Concepts consists of (1) Positive Definition, (2) Scientific Phenomenon Prediction and (3) Logical Thinking. This is important scientific learning competency which should be developed to primary school students in the future.

Keywords: predict - observe - explain, technology, scientific explanations making, change of substance, primary school

1. Introduction

The world is stepping into a fully limitless world without boundaries to access information. Communication is convenient and fast. Medias of modern technology have roles in conducting life with people for all ages and genders especially among adolescents. There has been fast distribution of various medias and information technologies. There has been sending and receiving messages through using communication equipment such as

television, telephone, tablet, computer etc. Using digital technology is part of human behaviours becoming more extensive. This has been influenced by the belief system and valued directions determined by the majority of the society. From the survey results of using technology for education of Basic Education Commission, it was found that technology is a thing which increases educational opportunities to become convenient, fast, equal and thorough in students of all ages and every educational system for formal education, non-formal education and informal education. With correct use and knowing benefits, technology can be used as an efficient instrument to manage teaching and learning and build equality in receiving news conveniently, fast and keeping up with world situations regularly with no limits of learning. Moreover, world citizens under the age of 18 at the present time are born and grow with information technology facilitating life. As a result, conducting life is mostly consistent with the use of information technology a lot such as teaching and learning, communication and good exchanging and services etc. Among these world citizens, they are growing up to be the main power of the future world society which will be disruption society whereby humans try to adapt themselves in the society in which there are drastic changes with traditional beliefs which are declining. The society is facing this in new phenomena resulting from migration, natural disasters, environment, technology, population decrease, economy, politics and epidemic. This is the situation in which human beings will change the form of living in the future. These phenomena make the educational system turn back to revision and prepare students to be ready for any possibilities in dimensions which will occur to world citizens, namely climatic changes, epidemic situations, AI replacing human resources in the production system or interactions of people which have changed. All of these things will affect people's way of life changing completely in the future (Mangkhang, Kaewpanya, Jansiri, Nuansawan, Srichana, Anukul, & Saardluan, 2022).

Technology is an important instrument resulting from scientific progress. In fact, learning management science and new techniques have been adopted to be developed. Methods or techniques, methods of educational management (Wongsayun, 2015) which are in line with technology to help students learn correspond to scientific progress. As long as they correspond to scientific progress to bring about advantages or higher efficiency, they are deemed to be an alternative in learning management together with technology. Technological development will be consistent with designing learning activities on basis of the concept of content knowledge integrated with teaching methods. Educational technology (Koehler & Mishra, 2009; Jumrat, 2019) has development always consistent and parallel with products originating from the scientific process. As a result, educational technology has an image of focusing on the direction of using instruments, tools. This is misunderstanding. However, educational technology still has dimensions of technology with the system focusing on management, design and planning, operation according to plans and assessment. This is implementation for solving educational problems to bring about efficiency according to the goals.

Regarding the program for international student assessment or PISA, assessment of PISA focuses on assessing students' competence regarding using knowledge and skills in real life more than learning according to curriculum in schools or so-called literacy. This is divided into 3 issues as follows: (1) Reading Literacy; (2) Mathematical Literacy; and (3) Scientific Literacy. From the assessment results of Thailand based on assessment in 2019, it was found that Thai students had the average score of 393 marks (average OECD = 487 marks) for reading, 419 marks (average OECD = 489 marks) for mathematics and 426 marks (average OECD = 489 marks) for science. When compared with PISA 2015, it was found that the score decreased by 16 marks for reading and the score increased by 3 and 4 marks for mathematics and science respectively (Institute for science and Technology teaching Promotion, 2019). From the mentioned report, there is necessity indeed in teaching and learning science with efficiency. Also, literacy can be developed to students so that they have knowledge keeping up with social changes. This must begin with scientific explanations making development as a primary in order to extend skills of scientific learning in other dimensions further.

Scientific explanations making is the process which students express using scientific knowledge in a situation reasonably including being able to describe and interpret according to the phenomena as well as expecting or predicting changes which may occur. Moreover, students must be able to specify whether the description or the explanation determined for the situation is reasonable or how reasonable it is (Kitkueakul, 2005). Schooling management based on the technique of scientific explanation making will make students have critical thinking which is useful for learning about facts so that students do not rush into making conclusions for things easily. This also helps consider other main points, develop being observant, being able to find reasonable reasons and helps estimate probability and being able to make scientific explanations with reasons consistent with evidence.

Scientific learning management according to the knowledge creation theory based on the predictive-observation-explanatory (POE) schooling management approach is science teaching with efficiency which will promote students to express opinions and discuss about scientific concepts. It is the procedure to

present situations and to allow students to help predict what will happen. If there are any changes after students' prediction, students must observe the mentioned situation. After that, they must tell about what they have noticed and explain the differences between what they have predicted and observation results. The mentioned POE learning activities emphasizes this importance: Students have an opportunity to practice working like scientists. There is planning and designing for doing experiments to find the answers of the situations which the teacher has created whereby students must use the scientific process in searching for knowledge in terms of observance and building hypothesis, experiment-designing, taking actions in doing experiments. This is the procedure in knowledge investigation. When obtaining experimental results, students must explain the obtained results of the experiment. They must explain what is the reason of obtaining the result of the experiment. This is the method which promotes to build knowledge by themselves by relying on basic knowledge from their own experiences in investigation to find knowledge. This is in accordance with the goal of learning and teaching science (White & Gunstone, 1992).

From the above-mentioned statement, the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students will be an approach in managing learning so that students will learn from direct experiences, know how to use scientific equipment for doing experiments correctly and can explain the occurring phenomena scientifically with reasons and scientific literacy. They also can use the knowledge in everyday life happily.

2. Method

Step 1 Research form

This research is action research (AR). The research was conducted by collecting and analyzing data obtained from assessment forms and question items from group discussion. After that, the study results were presented in the form of descriptive analysis by using quantitative data and qualitative data supporting data synthesis and description.

Step 2 Population and samples in the research

The population used in the research consisted of 2 main target groups, namely (1) a group of experts assessing the learning management approach, namely staff of teachers, teachers of science and experts of science learning management and (2) the experimental group using learning management, namely 3 science teachers and Year 5 primary school students. Purposive sampling was used to come up with a total of 52 people making up for total samples in the research, namely:

- 1) A group of experts assessing the learning management approach, namely staff of teachers, teachers of science and experts of science learning management accounting for 9 people;
- 2) The experimental group using learning management, namely 3 science teachers and Year 5 primary school students accounting for 40 students

Step 3 The instruments used in the study

Instruments used for data collection consisted of:

- 1) Suitability Assessment forms of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students;
- 2) Question items of group discussion to distill the lesson learnt from the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students

Step 4 Data collection

1) Documentary study was conducted by collecting learning management data of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making from documents, books, journals and other secondary data sources appearing in the database. The reason of doing this was to collect basic data regarding the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making. Then, the obtained data were used to support the analysis of educational issues further.

2) Design and development referred to designing and developing the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students. Suitability was assessed by experts of learning management to implement

assessment results and suggestions to develop the learning management plan whereby the instrument used was the suitability assessment form of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students.

3) Distilling the lesson learnt is conducted after implementing the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students to organize learning and teaching in the classroom with group discussion together with teachers and students. The instrument used was the question item in the group discussion for distilling the lesson learnt regarding learning management of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students.

Step 5 Data analysis

1) For qualitative data, the researcher analyzed the data according to the educational goal by using the content analysis method and they were obtained from document analysis and interviewing to summarize issues according to data groups and to analyze relationships of the data.

2) For quantitative data, the researcher analyzed the data obtained from the assessment form by using the statistical package to analyze the data suitably. Descriptive statistics-based analysis was used whereby results of statistical data analysis were shown as mean and standard deviation.

3. Results

For the research at this time, the research team has classified the data obtained from the study and presented the research results according to the determined objectives. The study results can be summarized as follows:

1) Building and assessing suitability of the learning management plan of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students revealed that the researcher has designed the learning management plan of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students for 3 learning management plans by spending the whole 3 hours for learning. The process in organizing learning activities consists of 7 procedures called “*7P POE Technology based Learning Model*” with following procedures and details:



Figure 1. 7P POE Technology based Learning Model

Source: Chaijalearn, et al. (2023)

Table 1. Details of 7P POE Technology based Learning Model

Procedures of learning	Details
1) <i>Positive Stimulate</i> : P ₁	Positive Stimulate: P ₁ is the role of teachers who stimulate students' thoughts by allowing students to look at picture cards about changes of fruits when time goes by (raw bananas with ripe bananas) which the teacher has presented. After that, the teacher uses a question from the picture to ask the students "What do you think? Which picture comes before or after? How does the occurring processing go?. After the students answer the questions from the teacher, the teacher will extend the students' answers in order to connect to wider knowledge as well as reinforcing students positively to have a desire to learn.
2) Pre-debate: P ₂	Pre-debate: P ₂ is a discussion about details of using the equipment for doing experiments, result analysis, interpretation of occurring experiments and suggestions about safety in the laboratory of doing experiments.
3) Predict: P ₃	Predict: P ₃ is using the teacher's questions to stimulate the students' thought such as "Students, what do you think about this? In everyday life, what are things which are changes of the substance similar to the situation which I gave as an example previously?"
4) Post-debate: P ₄	Post-debate: P ₄ is giving examples of each student and jointly summarizing the occurring issue to reflect viewpoints of students' thought regarding changes of the substance and students summarize together the concept regarding chemical changes of the substance occurring in everyday life of things which the students mutually consider from the thing which the students give an example.
5) Participant Observation: P ₅	Participant Observation: P ₅ is observing the teacher's experiment together with students through doing the experiment and making observation of changes of the substance occurring from doing the experiment about the chemical reaction between potassium permanganate (KMnO ₄) and hydrogen peroxide solution (H ₂ O ₂).
6) Phenomenon Explanation: P ₆	Phenomenon Explanation: P ₆ is explaining the phenomena occurring from the chemical reaction of the bubble gas showing chemical changes.
7) Practice: P ₇	Practice: P ₇ is turning on the virtual experiment program in the phone to extend the knowledge of the students about chemical changes in everyday life so that the students can watch it to bring about more understandings and the students can connect the knowledge to real life.

Source: Chaijalearn, et al. (2023)

After designing the lesson plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students revealed that the researcher has designed the lesson plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students, the researcher had suitability of the lesson plan assessed by experts of learning management whereby assessment results revealed as follows:

Table 2. Assessment results of suitability of the lesson plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students (n=9)

No.	Assessment item	\bar{x}	SD	Interpretation
1	The lesson plan was consistent with the learning standard according to the core education curriculum and schools.	4.78	0.44	Highest
2	The lesson plan promoted awareness of importance of science study with knowledge in everyday life.	4.67	0.71	Highest
3	The lesson plan covered developing students to have important knowledge, skills, processes, competencies and desired characteristics.	4.56	0.73	Highest
4	The lesson plan plan promotes scientific literacy.	4.67	0.71	Highest
5	The lesson plan gave an opportunity to bring about the discussion process and participation in exchanging learning.	4.89	0.33	Highest
6	The lesson plan promoted being an active citizen of students.	4.67	0.71	Highest
7	The lesson plan promoted creative thoughts.	4.33	0.71	High
8	The lesson plan had content which was in line with local learning resources.	4.56	0.73	Highest
9	The lesson plan had various learning medias which were useful to scientific education.	4.78	0.67	Highest
10	The lesson plan promoted changes of value domain, cognitive domain, psychomotor domain and affective domain.	4.67	0.71	Highest
11	The lesson plan had various learning medias used in supporting learning.	5.00	0.00	Highest
12	The lesson plan assessed students' progress based on various approaches suitable with the nature.	4.44	0.88	High
Overview of assessment results		4.67	0.61	Highest

Source: Chaijalearn, et al. (2023)

From Table 2, assessment results of suitability of the lesson plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students were at the highest level ($\bar{x} = 4.67$, $SD = 0.61$). When individual issues were taken into consideration, it was found that the lesson plan had suitability assessment results at the highest level consisted of following issues: The lesson plan had various learning medias used in supporting learning ($\bar{x} = 5.00$).

The lesson plan gave an opportunity to bring about the discussion process and participation in exchanging learning ($\bar{x} = 4.89$). The lesson plan was consistent with the learning standard according to the core education curriculum and schools ($\bar{x} = 4.78$) and the lesson plan had various learning medias which were useful to scientific education ($\bar{x} = 4.78$) respectively.

2) From distilling lessons learned of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students, it was found that scientific learning competency called Scientific Explanations Making Concepts or PSL consisted of: (1) Positive Definition; (2) Scientific Phenomenon Prediction; and (3) Logical Thinking. This is the important scientific learning competency which should be developed to primary school students in the future with following details:

Table 3. Details and characteristic of Scientific Explanations Making Concepts

Scientific Explanations Making Concepts	Details	Empirical works
1) Positive Definition	Use scientific knowledge to make explanations reasonable and in line with learning evidence	Students did experiments regarding changes of the substance whereby there was equipment used in the experiment as follows: Rubber gloves, beakers, syringes, substance-stirring rods, a spoon to scoop hydrogen peroxide (H ₂ O ₂), potassium permanganate (KMnO ₄), dishwashing liquid. The teacher allowed the students to choose tools and chemicals. After that, the students followed the step to do the experiment by starting to put on the gloves and used 3 grams of potassium permanganate (KMnO ₄). After that the students observed changes and recorded the results.
2) Scientific Phenomenon Prediction	Lecture or interpreting phenomena and predicting scientific changes	Students prepared activity sheets by reading explanations. After that, students analyzed and predicted chemical changes from the activity sheet which the teacher handed out and recorded the results in the activity sheet (through the worksheet showing food pictures. After that, students predicted changes of the food whereby students can predict other changes in everyday life) whereby students can predict scientific changes.
3) Logical Thinking	Identification can say that saying describes explanation and which prediction is reasonable	Students prepare activity sheets whereby students explained chemical changes from pictures which students will be able to connect with everyday life. Students read explanations and answered questions which students were able to identify and explained that which prediction was reasonable.

Source: Chaijalearn, et al. (2023)

Therefore, Scientific Explanations Making Concepts or PSL is deemed to be an important scientific learning competence which should be developed to primary school students to promote scientific literacy and efficient scientific learning competence, which can be summarized as in the picture:

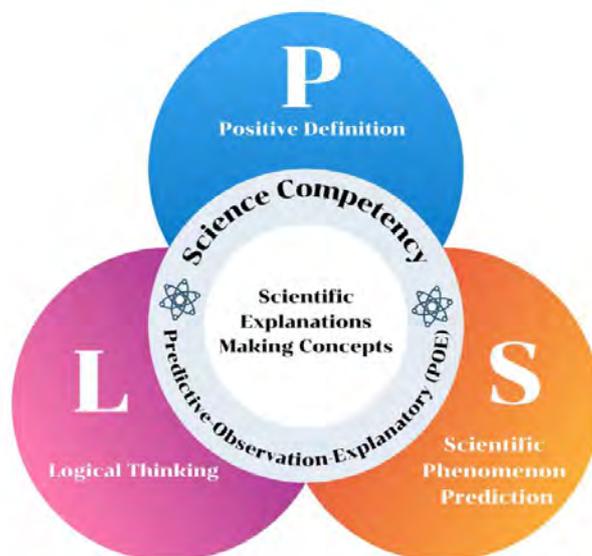


Figure 2. Scientific Explanations Making Concepts or PSL

Source: Chaijalearn, et al. (2023)

4. Discussion

1) Building and assessing suitability of the learning management plan of the learning management plan of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students has brought about 3 learning management plans by spending a total of 3 hours for learning. The process in organizing learning activities consists of 7 procedures called “7P POE Technology based Learning Model” consisting of (1) Positive Stimulate, (2) Pre-debate, (3) Predict, (4) Post-debate, (5) Participant Observation, (6) Phenomenon Explanation and (7) Practice. The result of suitability assessment was at the highest level. This is consistent with Haysom & Bowen (2010) stating that organizing POE learning activities is teaching according to the constructivist approach focusing on challenging students to participate in the learning process. Moreover, Laemkaew, Chaloeivaret and Poomsamlee (2014) have found that the predictive-observation-explanatory teaching technique is the efficient technique which will promote students to express opinions and discuss scientific concepts into steps, create fun and enthusiasm in learning. Students have an opportunity to practice the skill of observing, making a survey, searching, predicting, explaining, summarizing and making assessment. Students learn from actual conditions. They know how to make a plan in working and to work in a group. They actually practice according their own abilities. They are assessed, which is consistent with the subject matter they learn. They have clear understanding of the thing they learn. This can be applied in real life and is in the same direction with Shuesungnoen (2016) discovering that organizing learning activities which students learn from predicting, observing and explaining makes student have a good time and also make them feel challenged, resulting in bringing about efficiency in learning. They have also been developed at their capacity. It is an efficient method which focuses on making students think and use the language as an instrument in communication. This makes students know how to think, able to build knowledge on the basis of knowledge, experiences and the social and environmental context, experiences which have been obtained.

2) From distilling lessons learned of the learning management of the predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students discovered scientific learning competency called Scientific Explanations Making Concepts or PSL consisted of: (1) Positive Definition; (2) Scientific Phenomenon Prediction; and (3) Logical Thinking. This is the important scientific learning competency which should be developed to primary school students in the future. This is consistent with the theoretical concept of Office of Basic Education Commission, Ministry of Education (2015) stating that organizing POE learning activities can help students explore and search for, and find reasons to explain about their thoughts. For the step of Predict, students predict as well as give supporting reasons. For the step of Observe, students take actions in observing what has happened in details and record results. For the step of Explain, students explain by giving reasons, which brings about learning in

students. This corresponds to the discovery of Kearney et al. (2001) finding that organizing Predict-observe-Explain (POE) learning activities together with using computers results in making students come up with learning meaningfully in learning. From distilling the lesson learnt together with teachers and students who have learnt from learning management at this time obtained reflection of higher learning development and helped students have competency of important basic learning which can be extended in learning science in the future.

5. Conclusion

The predictive-observation-explanatory (POE) technology based learning approach to promote scientific explanation making about the change of the substance for primary school students be an approach in managing learning so that students will learn from direct experiences, know how to use scientific equipment for doing experiments correctly and can explain the occurring phenomena scientifically with reasons and scientific literacy. They also can use the knowledge in everyday life happily.

6. Suggestions from the Research

6.1 Suggestions for Implementing Research Results

1. Teachers can organize learning activities by designing schooling management in accordance with the area-based, environmental context and the context of schools so that students can implement the knowledge to bring about usefulness everyday life.
2. Local wisdom should be used as predictive-observation-explanatory learning medias together with using technology to promote bringing about lifetime learning of students.

6.2 Suggestions for Next Research

1. Results of the learning management plan of the predictive-observation-explanatory (POE) technology based approach to promote scientific explanation making about the change of the substance for primary school students in areas with different contexts should be studied.
2. Results of the learning management plan of the predictive-observation-explanatory (POE) technology based approach to promote scientific explanation making in the form of digital medias should be presented to promulgate the knowledge and exchange learning in the area of social media learning.

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