A Study of Learning Management Model that Promotes Scientific Literacy for Pre-Service Teacher

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Abstract. This collaborative research aimed to synthesize a teaching model promoting scientific literacy and then monitor how pre-service teachers implement and experience it in real classrooms. Three science pre-service teachers who enrolled in the internship course participated in this study as case studies. Research data was collected by interviews and classroom observations and analyzed through content analysis. Method triangulation was used to ensure the credibility of qualitative data. The research findings indicated that the pre-service teachers had professional experience in the teaching model implementation in five aspects: 1) the limitations of the teaching model; 2) student scientific literacy; 3) self-awareness about teaching; 4) learning management; and 5) learning environment. Furthermore, the finding revealed that they, as science teachers, had to have enough scientific content knowledge to be able to critique and identify which content knowledge was relevant to a particular social situation. Then they used that situation to launch classroom discussion activities in the teaching model. If a science teacher were unable to identify a wide range of scientific knowledge, it would hinder their students' ability to link science in society.

Keywords: scientific literacy, learning management model that promotes scientific literacy, pre-service science teacher

1. Introduction

Science is one of the most important subjects of teaching and learning in the twenty-first century. It plays an essential role in raising public awareness in society because it enables people to develop rational and creative thinking, acquire the critical skills in knowledge research, systematically solve problems, make decisions based on a variety of data, and provide verifiable testimony. As above abilities are compatible with the International Student Assessment Program in Science Literacy (IPST, 2017), which evaluated 15-year-old pupils in all OECD nations, including Thailand.

The Program for International Student Assessment (PISA)PISA establishes a framework for the scientific assessment structure that consists of the first component context, scientific knowledge, and scientific competence by recognizing situations in life at the individual, national and global levels, even in the present or in the past. It is necessary to have understand of science and technology as well as an understanding of facts, key concepts, and crucial theories that form the basis of scientific knowledge. It

contains knowledge of the natural world and technological inventions (content knowledge), knowledge of the methods of conceptualization (process knowledge), and an understanding of the fundamental rationale of the knowledge-building process. It contains knowledge of the natural world and technological inventions (content knowledge), knowledge of the methods of conceptualization (process knowledge), and an understanding of the fundamental rationale of the knowledge-building process (knowledge acquisitions) in order to provide the ability to 1) explain phenomena in a scientific phenomenon, 2) assess and design processes in the pursuit of scientific knowledge, and 3) interpret data and use scientific testimony in which these three emphases are combined. People encounter with a range of real-life circumstances involving themselves, their communities, their countries, and the world. As a result, we must possess and employ the ability to respond to and solve situations in a fair manner. All of the above is called Scientific Literacy.

Scientific literacy is the ability of a person to communicate or argue about issues related to science and technology rationally. In which the person needs to know and use many elements, including the context or situation of science. scientific knowledge and scientific competence (PISA, 2018). Which at present There has been a rapid change in the economy and society, making human livelihoods. more relevant to science. However, the Program for International Student Assessment (PISA) measures competence in all three areas: reading, math and science. In terms of science, Thai students tended to have better results in science assessments than reading and math. Approximately 56% of Thai students have a science proficiency at level 2 or higher. The average of OECD member countries is 78% of students with this level. By this level, students can obtain accurate descriptions of familiar and not too complex scientific phenomena. Scientific knowledge can be used to tell whether the conclusions are accurate and consistent with the available data.

All The Institute for the Promotion of Teaching Science and Technology (IPST, 2018) states that in the latest 2018 Science Intelligence Assessment, Thai students had an average reading point of 393 (OECD with a mean of 487) 419 Mathematics points (OECD with a mean of 489) and 426 Science points (OECD with a mean of 489) when comparing to PISA 2015, there was a 16 point decrease in reading for reading. Mathematics and Science were increased by 3 points and 4 points respectively. For the statistical test, the math and science aspects were unchanged compared to the previous assessment cycle. However, when analyzing the trend of point changes from the first round of assessments to the present, it found that mathematics and science assessment results in Thailand were unchanged. The reading assessment results tended to decline continuously.

Based on the above situation, Muhammet (2020) suggested that developing learners to become scientifically literate students may need to be cultivated at an early age and related departments. It should make scientific literacy the goal of science education at the elementary level. This is because learning at the elementary level is the first step of compulsory education (Compulsory Education) that builds on learning at the early childhood level, and is a crucial time in life for identity development. It is an educational level that aims to lay the foundations of life in every aspect, including reading, writing, numeracy, and fundamental subjects. The development of knowledge and skills acquired during this period will be the fundamental cost for further development of knowledge and skills in secondary education (Jaiyeoba, 2011). But if the learners who start their education poorly are typically unable to make good progress in the following years (Burcu ÖKME, Şeyma ŞAHİN, Abdurrahman KILIÇ, 2020). Therefore, building a foundation of scientific literacy for learners under the age of 15 will help students succeed in their future life.

This is due to the fact that students must live in a fast-changing environment based on reason and consequence, as well as apply their scientific knowledge to make educated judgments in the context of the sciences around them. Reasons for this (Muhammet, 2020) Learners will be able to learn and advance if they can adjust to the changes that occur. On

the other hand, if students are unable to adjust to changes in the interface, this failure to adapt might represent a significant barrier to learning. As a result, it is the teacher's responsibility to encourage and assist students in learning science in a meaningful way. On the other hand, teachers are critical to students' learning, particularly throughout the student experience, since it prepares them for future real-world practice. Students can face real-life issues involving self, local, country, or global situations and reasonably solve problems if pre-service teachers exercise professional experience.

All above- mentioned studies, the researcher is interested in studying the effect of using a learning management model that promotes scientific literacy. Pre-service teachers practice teaching professional experience that the researcher has synthesized from various research studies to be the benefits in learning management, promoting scientific intelligence for pre-service teachers to practice teaching a professional experience to be more effective.

2. Methodology

This paper is a qualitative research case study with interpretation and content analysis methods as follows:

2.1. Target group

The participants consisted of three general science pre-service teachers studying in the second semester of Academic Year 2021. They were selected by purposive sampling as university students who are training about teaching in the school and who are responsible for the management of science learning in grade 7-9, 2nd semester, and the academic year 2021 at 3 large schools in Phetchabun as shown in Table 1.

Table1: showing the fundamental information of the participant

Schools	Code	Level class responsibility	Content	Hours
A	ST1	Grade 7	Weather forecasting	3
B	ST2	Grade 8	Earth's Changing Surface	3
C	ST3	Grade 9	Components of Ecosystem	3

2.2 Methods of Inquiry

For this research, the data collection was conducted by interviewing pre-service teachers with professional experience before and after each teaching, face-to-face during the interview. The researcher requested permission to record the conversation for use in transcription. The conversation was sent back to the interviewed pre-service teachers to check for a member check. In addition, the researcher made a note of noticeable points during the interview and while the students were teaching. The researcher also observed the teaching of the students at all times.

Qualitative data analysis, was used by bringing the chapter interview for preparing and the information for coding and categorizing that correlated according to the issues coded and brought to conclusions using evidence from interviews and report the results of a detailed analysis of interviews with examples of thick description.

The reliability of the data analysis results was checked during the conduct of the research. The researcher will discuss the data collection and analysis results with peer debriefing and check by member checking.

3. Research Findings

Research findings on the study of the use of a learning management model that promotes scientific literacy. The researcher will report on two objectives: synthesis of learning management model that promotes scientific intelligence; For pre-service teacher and to study the effect of using a learning management model that promotes scientific literacy for pre-service teacher in order of research objectives

Research objective 1 : To synthesize a learning management model that promotes scientific literacy for pre-service teachers

Table 2 : shows a synthesis of learning management models that promote scientific intelligence.

Model 1 (Sri Rahayu.2017)	Model 2 (Ashlyn E. et. al. 2020)	Model 3 (Kultida. et. al. 2018)	Model 4 (Eliyawati et. al. 2017)	*New Model*
1) Choose a chemistry content that has characteristics of rich applications in daily live	1) Review article	1) Motivation	1) Contact Phase	**1) Choose situation in daily live**
2) Utilize inquiry and constructivist approach	2) Test	2) Exploration	2) Curiosity Phase	**2) Brainstorming**
3) Integrate nature of science (NOS)	3) Group to work	3) Brainstorming	3) Elaboration Phase	**3) Exploration**
4) Construct socioscientific issues related chemistry	4) Presentation and discussion	4) Decision making	4) Decision Making Phase	**4) Decision making**
5) Allow students to collaborate each other to solve a problem	-	-	5) Nexus Phase	**5) Application**
6) Allow students to communicate	-	-	6) Assessment Phase	-
7) Choose interesting	-	-	-	-

Model 1 (Sri Rahayu.2017)	Model 2 (Ashlyn E. et. al. 2020)	Model 3 (Kultida. et. al. 2018)	Model 4 (Eliyawati et. al. 2017)	*New Model*
socioscientific / contemporary issues to increase student's curiosity.				

Learning management that promotes scientific literacy that the researcher has synthesized from there are details in each step of learning management such as teaching principles in each step, goals, roles of teachers, and roles of learners. Which will be reported as shown in table 3.

Table 3 : Details in each step of learning management step.

New Model	Teaching principles	Goals	Roles of teachers	Roles of learners
1) Choose situation in daily live	Teachers provide situations that occur in everyday life. and related to science as an import to the learning of the class and using questioning to get students to identify science-related issues.	identify science-related issues.	- Provide situations that occur in everyday life - Open-ended questions - Give more feedback	- identify science-problem - answer
2) Brainstorming	Brainstorming within groups to analyze, understand, and identify knowledge relevant to the situation. Problems or knowledge that require further from the situation to use for proof or problem solving	- Identify of scientific knowledge relevant to the situation	- Use questions to make students relate their science knowledge to the situation.	- Exchanging knowledge within the group - Analyze and understand the problem - Communicate knowledge that comes out
3) Exploration	Exploring and searching for knowledge, such as searching, experimenting, asking people who know, or observing related phenomena.	- Scientific inquiry	- Use causal questions in order for students to have a process of thinking from the result of the inquiry	- Search for information (evidence) that you want to know more - Use science process skill for scientific inquiry

New Model	Teaching principles	Goals	Roles of teachers	Roles of learners
4) Decision making	Must decide on a solution to the problem. of the group thought to be the best overall method	- Explaining the situation with scientific evidence	- Use open-ended questions to point out different opinions. to give students more options and allow learners to express their opinions in a variety of aspects	- Use testimony Scientific evidence for opinion or argued on some issues
5) Application	To use the body of knowledge on that subject to explain and make decisions in different situations	- Explaining the situation with scientific evidence	- Use open-ended questions - provide different situations - Encourage students to use the knowledge they have acquired to critique new situations.	- Explaining the situation with scientific evidence - Make decisions in different situations

The researcher conveyed the teaching method by mutual understanding with the students through a step-by-step guide. to create understanding As an example of this conversation

"I am so confused. Brainstorming and Exploration, I think it's confusing. Because after brainstorming and researching for answers, it would cause the teaching to overlap."

ST1, 15 February 2022

Researchers and pre-service science teachers work together to come up with situations that can be used in learning activities. An example of the instructor's answer in selecting the situation "5000 liters of oil leak in Rayong", which the instructor commented on.

"This situation should be suitable for students. because it is an issue that is not an issue for long Students may have heard of it. and close to you as well."

ST3,17 February 2022

When some steps get confused The researcher explained further. along with an example to illustrate for students to visualize and more understand. This synthesized form of learning management to promote science literacy was applied to learners at all three levels. Therefore, the researcher will continue to report the results of using the learning management new model as the second objective.

Research objective 2 : To study the effect of using a learning management model that promotes scientific literacy for pre-service teachers

From the interview first question found that after the management of science learning. The students were interviewed as follows:

Researcher: What do pre-service teachers think they have learned from using a learning management model that promotes scientific literacy?

ST1 : After teaching I think that the management of science learning that makes the learners to be intelligent and knowledgeable of science. It is necessary to link knowledge from situations that are well applied at the beginning of the hour.

ST2 : I think the teacher's scientific knowledge must be very accurate because it must be used to explain phenomena with rationality.

From the interview was concluded that the pre-service teachers are the importance of scientific knowledge and the situation used including explaining the phenomena that occur rationally.

When experimenting with teaching to promote scientific literacy can report the results of the experiment in five aspects as follows:

1) The limitations of the teaching model;

This New model is specific to content that can be applied to real-life situations such as force and motion. It is therefore important to organize learning in order. As a research by Kultida Chanapimuk. et. al. (2018), which included the subject matter that raised the question of students with environmental problems. And the next step will make students ask various questions. And the questions can be separated into issues so that students can see the categories of questions. and guidelines for finding answers. An additional finding from using the learning management model to promote scientific intelligence is that students are more assertive. As opposed to the information that the teacher gave before planning to learn that the students in this room would not dare to express themselves. or comment in class. In addition, another important finding was that the teacher's questioning skills had to be very good. because the teacher was unable to control the situation or directions for sharing information that learners find from the social media. Questioning skills to come to a common conclusion therefore important and it's

part of the classroom management this time as well. It can be seen from the interview as follows:

Researcher : What problems in this teaching ?

ST3 : The teacher's questioning is not diverse enough. because I will only ask the content No connection to the situation Therefore, students are unable to explain the phenomenon in a scientific way.

2) Student scientific literacy;

Student still can't identify the issue and scientific knowledge relevant to any given situation. And learners can create descriptions. But still unable to find evidence to support the scientific explanation (Benjamin C. Herman et al., 2019). As an example of student work as shown in Figure 1.

Figure 1 : Example of student work 1

From Figure 1, students can see that agree or disagree with the situation adopted for 'building a dam', but it's still not very good to explain the evidence to support your opinion reason to come also a common reason not as specific to the situation as it should be and not enough information. The opportunity for students to find information is another interesting point. Because finding information to support their own opinions obtained from unreliable sources as shown in Figure 2.
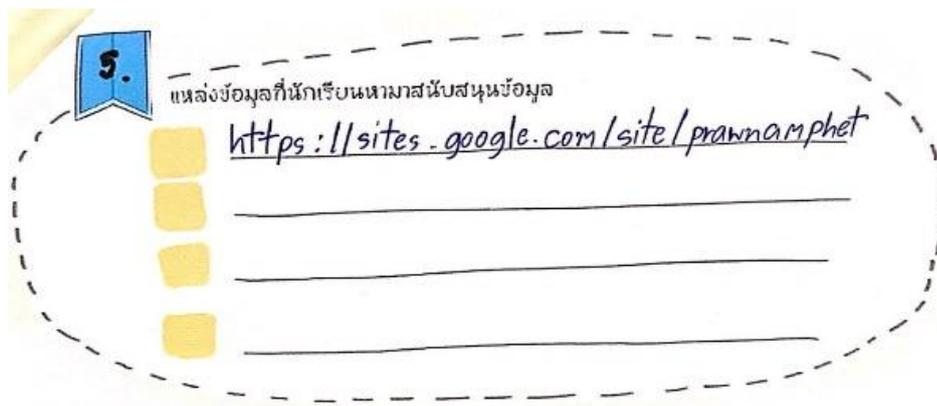
Figure 2 : Example of student work 2

The information that students gathered to support their opinions was obtained from general websites. That is not specific to scientific knowledge. As a result, students are unable to explain their opinions reasonably.

3) Self-awareness about teaching;

Teachers must therefore use questions to come to a conclusion or reasonable explanations with evidence to enable learners to understand scientific content. Teachers must have the skills to connect science content to their surroundings for teachers. If the teacher has no knowledge of the content, the teacher will not be able to relate the content to any situation at all. (Koh & Chai, 2014)

4) Learning management;

The duration of the activities should be sufficient for gathering information and evidence to create an explanation. The nature of the situation must be real daily life or hot issue.

5) Learning environment.

Environment for learning management students must learn in groups. Because of the step brainstorming is required to identify the knowledge relevant to the situation. And the teacher's classroom management must be relaxed. Do not put too much pressure on students.

Furthermore, the finding revealed that they, as science teachers, had to have enough scientific content knowledge to be able to critique and identify which content knowledge was relevant to a particular social situation. Then they used that situation to launch classroom discussion activities in the teaching model. If a science teacher were unable to identify a wide range of scientific knowledge, it would hinder their students' ability to link science in society.

4. Conclusion

The conclusion indicated that the pre-service teachers had professional experience in the teaching model implementation in five aspects: 1) the limitations of the teaching

model; 2) student scientific literacy; 3) self-awareness about teaching; 4) learning management; and 5) learning environment. Furthermore, the finding revealed that they, as science teachers, had to have enough scientific content knowledge to be able to critique and identify which content knowledge was relevant to a particular social situation. Then they used that situation to launch classroom discussion activities in the teaching model. If a science teacher were unable to identify a wide range of scientific knowledge, it would hinder their students' ability to link science in society.

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