The Nature of Science Views among Intern General Science Pre-Service Teachers

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Abstract. This research aimed to study the nature of science views of 23 students who are currently intern general science pre-service teachers in one of Rajabhat Universities in the North. The research instrument used in the study was: the nature view of science questionnaire developed by Haidar (1999) and the researcher has improved it in accordance with the curriculum of science and education in Thailand. The nature of science views had three aspects totally 27 items. There were 8 items for scientific world view, 4 items for the scientific knowledge inquiry, 6 items for scientific enterprise and they were totally 18 items and open-ended question on the nature of science views with three aspects of science in the world: 3 items for scientific world view, 3 items for scientific inquiry and 3 items for scientific enterprise. They were totally 9 items. Then the data were analyzed by grouping the answers and finding the percentage. The results of the research revealed that intern general science pre-service teachers had the same view of the nature of science that was consistent with 3 aspects of the traditional view. That were the 2nd aspect; scientific inquiry. The 1st aspect; scientific found that 91.30\% better understood consistent with the traditional view that working of a scientist must be based on a scientific method that has a definite sequence of steps. As the 2nd aspect; the scientific knowledge creation found that 78.26\% had the consistency of understanding with the traditional concept. It stated that scientific knowledge is created by observation, survey or experiment. The 3rd aspect; evidence and imagination, and creative thinking, it affects the scientific knowledge creation. It showed that 73.91\% had an understanding that is consistent with the traditional concept that scientists acquire scientific knowledge using only evidence-based. The findings indicated that intern general science pre-service teachers still have many points of view. The most necessary thing is teachers need to use teaching and learning methods that solve the problem of natural science erroneously in the course of learning science management before the students go for the practicum.

1. Introduction
The nature of science is the heart of the scientific literacy. It identifies the nature of science in the national and international science curriculum [3] because science is a culture of the modern world, a knowledge-based society, Therefore, everyone needs to be developed for science in order to understand nature and the technology that human create and apply it reasonably [19] The main aim of teaching and learning science, which scientists study and organizations around the world have
accepted the role of science’s nature in teaching science as well as countries that include the nature of science in the curriculum, such as Australia, Canada, South America, the United Kingdom, the United States and New Zealand [12]. Thailand raises an awareness of nature of science as importance and it shows on the standards of science learning in the 8th core curriculum of Basic Education 2008 [18]. The nature of science enables students to acquire their knowledge by themselves, create new knowledge, understand the nature and limitations of science including the impact of science, and technology to society. These understanding of the nature of science will improve the attributes of science. [20]

Scholars have defined the meaning of nature in many ways [11]. states that the nature of science is directly related to epistemology with values and hypotheses as well as scientific processes. It is also a development of scientific knowledge, where scientific knowledge is independent of thought [14]. states that the nature of science is a harmonious blend of sociological study of science in many aspects, including the history of science, sociology and philosophy of science, as well as the study of scientific knowledge. In addition, [15] argue that the nature of science is a combination of various social sciences, including history, sociology and philosophy of science [7]. also supports that the nature of science refers to the study of scientific knowledge; it is the method by which the scientist derives his knowledge of the work or society of the scientist and the value of science to society. According to this definition shows that the nature of science does not pay only attention to scientific knowledge but also the process of gaining scientific knowledge, skills used in the quest for knowledge and work or society of scientists and the value of science to society associating the relationship between science and technology, and society.

From the results of both local and international research, it has been found that teachers have misunderstandings about the pursuit of scientific knowledge and the influence of society and culture on scientific work [6] Additionally, the study of the nature of science’s views among intern pre-service teachers in Promotion Science and Math Teacher Project (PSMT) indicate that the students think creative thinking and imagination have no part in creating science. Moreover, social factors and cultural factors have no impact on records of scientists [10] This is consistent with the study of the students’ views among intern pre-service teachers towards Brunei teachers as the scientific knowledge inquiry that imagination and creativity do not contribute to the creation of scientific knowledge [22] Research in the field of science has found that the lack of understanding on the nature of science by science teachers results in the inability to integrate science teaching[17] Moreover, the results showed that the students lack understanding and misunderstand about the nature of science in many aspects, such as the steps and methods of scientific knowledge inquiry, meaning and origin of rules and theories, factors affecting the work of scientists, influence of social and cultural relations on science. As mentioned above, there are research studies in science education to solve the problem of understanding the nature of science about the development of science teachers to develop the curriculum of teaching about the nature of science. The studies review that most of intern general science pre-service teachers have views about the nature of science, but lacking in profound understanding of theology. It requires more effort in teaching and learning.

However, today it has found, students also lack the understanding of the nature of science. The main reason is that teachers have misunderstandings like understanding that science is only scientific knowledge and they do not take into account the process of acquiring scientific knowledge. Organizing science learning activities and the 8th core curriculum will be successful or not, teachers are very important persons to develop students' understanding of the nature of science. Institute for the Promotion of Teaching Science has set the standard of science teachers that "Teachers should understand the nature of science and technology, including the content structure of the curriculum and the knowledge of science and technology, the concept of inquiry and problem solving. It can also be used to create a learning experience that makes the course content meaningful to students.", which is consistent with teacher standards in the United States that encourage teachers to teach the nature of science to students as well [21].The teachers have accurate idea about the nature of science and have an understanding of the teaching process that corresponds to the nature of science. It improves the
efficiency of science teaching and encourages students to become knowledgeable scientists [16]. Learning the nature of science is paramount. Those who do not have the science of nature cannot convey the nature of science to the students [1]. Currently, most of educational institutes of science teachers in Thailand have not had any specific courses in the nature of science and what students or students are learning in the course “How to teach science.” Of course, if the intern general science pre-service teachers understand the nature of science and realize that the nature of science is important to the students, the teacher training students will be able to integrate the nature of science into teaching. Therefore, the teaching of the nature of science is essential.

In order to be successful in teaching and learning, teacher is one of the key factors contributing to the teaching and learning of the nature of science, as evidenced by the standards of science teachers of the Institute for the Promotion of Teaching Science B.E. 2002 (IPST) as in the 1st standard, teachers must have an understanding of the nature of science and technology in terms of knowledge-based content, consistent with teacher standards in the United States that encourages science teachers [21]. Based on the objectives of the nature of the science teaching management, it emphasizes on the understanding of teacher including problems of teaching and learning science. Therefore, the researchers have the interest to study the nature of science’s views among intern general science pre-service teachers to be as the basic information and to develop students to understand the nature of science and to be used in the development and improvement of the curriculum of science teachers in the future.

2. Objective of the research
To study the nature of science among intern general science pre-service teachers practicing professional science teachers.

3. Approach of the study
The research conduction on "The Nature of Science Views among Intern General Science Pre-Service Teachers" is descriptive research, which is an in-depth study with the group with less people to obtain information describing the ideas and insights of intern general science pre-service teachers.

4. Research participants
The target group is 23 of the 5th year’s students of Bachelor of Science Program in Science Faculty, majoring in General Science, academic year of B.E. 2560. The samples were selected as the purposive sampling, consisting of 2 males and 21 females and they have currently trained as intern general science pre-service teachers were chosen by the purposive sampling.

5. Pre-service teacher professional development
The researchers have developed a questionnaire about the understanding the nature of science as in sequence. The questionnaire is based on the conceptual framework of the question showing the views about the nature of science. Each item contains 2 messages; the left side is the message on the nature of science based on traditional ideas. The message on the right is a natural science based on the theory of creating new knowledge, covering 3 aspects: the scientific world view, the pursuit of scientific knowledge, and scientific enterprise.

5.1 Research Instrument
The questionnaire is about the nature view of science developed by Haidar (1999) and the researcher has improved it in accordance with the curriculum of science and education in Thailand. The nature of science views has three aspects totally 27 items.

5.1.1 Closed-ended questionnaire is the natural view of science. There are 3 aspects: scientific world view, 8 scientific inquiry, 4 science-related questions, and 6 scientific enterprise. They are totally 18 questions
5.1.2 *Open-ended questionnaire* is on the nature of science views with three aspects of science in the world: 3 items for scientific world view, 3 items for scientific inquiry and 3 items for scientific enterprise. They are totally 9 items.

5.2 *Data Analysis*

Analytical data of the nature of science is in accordance with [8] analytical criteria, having a philosophical view of the nature of science, are divided into two perspectives: the traditional view of nature and the contemporary science view has the details as follows:

5.2.1 *The traditional view of nature is based on two philosophical ideas:* the concept of realism: this is a view on scientific theories and explanations. The second one is empiricism: this is a view on scientific knowledge and the development of scientific knowledge.

5.2.2 *Nature view of theoretical knowledge as constructivism view is based on two philosophical ideas:* instrumentalism is a view on theories and scientific explanations and constructivism is a view on scientific knowledge and the development of scientific knowledge.

The researcher analyzed the relevance of the data by reading each student's answers to each question, interpreted the answers and grouped their understanding in accordance with the setting criteria. The data was analyzed twice, and the second time was sent to the experts who were scientists to investigate one more time.

6. *Research findings*

According to the analysis of data, the overall opinions of the intern general science pre-service teachers had the most traditional views on the nature of science, varied from the highest level to the lowest level as steps of scientific method, methods to create scientific knowledge and evidence with imagination and creative thinking that affect scientific knowledge creation. The theory of knowledge creation is in descending order as relationship of scientist, rules and scientific model theories and the collaboration of scientists. It is noteworthy that the second issue, the scientific knowledge inquiry. The intern general science pre-service teachers had the view to be consistent with the three traditional concepts, where each information and sub-topic is shown in Tables 1-3 and the following description.

### Table 1. Nature of Science Views as the 1st Aspect; Scientific World View of Intern General Science Pre-Service Teachers

| Issues of Nature of Science | Item | No. of Answers (percentage) | (N =23) |
|-----------------------------|------|-----------------------------|--------|
| 1. Meaning of the nature of science’s characteristics. | 1 | 8(34.78) | 0(0) | 15(65.22) |
| 2. Scientific knowledge as the explanation for understanding nature. | 4 | 15(65.21) | 1(4.35) | 7(30.43) |
| 3. Development of scientific knowledge. | 7 | 6(26.08) | 3(13.04) | 14(60.86) |
| 4. The persistence of scientific knowledge. | 10 | 2(8.69) | 6(26.08) | 15(65.21) |
| 5. Creation of scientific knowledge for nature explanation. | 12 | 8(34.78) | 4(17.39) | 11(47.82) |
| 6. Characteristics of rules. | 13 | 3(13.04) | 6(26.08) | 14(60.86) |
| 7. Source of theories. | 14 | 13(56.54) | 3(13.04) | 12(52.17) |
| 8. Scientific Modelling. | 17 | 3(13.04) | 3(13.04) | 17(73.91) |
|                           |     | 30.44 | 13.04 | 56.52 |
Based on the analysis of the data from the questionnaire on the scientific world view among intern general science pre-service teachers, it was found that 56.52% had a consistent view of the theory of knowledge creation and 30.44 % had a consistent view of traditional idea and 13.04 % of the respondents was uncertain. There are several issues that correspond to the theory of knowledge creation in descending order as scientific modelling 73.91% of the respondents considered it as a "rational or logical simulation in terms of the meaning and nature of science", 65.22 % argued that "scientific knowledge is a human explanation for the understanding of nature, but not everything is real and some scientific knowledge cannot be proved." As the issue of the persistence of scientific knowledge, 65.21% agreed that "knowledge of scientists is acceptable and can be changed". The issue is in line with the traditional view as following order scientific knowledge as the explanation for understanding nature. 65.21% argue that scientific knowledge is a fact that occurs in nature and the source of theories, 56.54 percent had the reason that "scientific knowledge has been accepted because it is proven by the theories to explain what we study."

Table 2. The Nature of Science View: The 2nd Issue: Scientific Knowledge Inquiry of Intern General Science Pre-Service Teachers in each issue.

| Issues of Nature of Science | Item | Traditional View | Uncertain | Knowledge Creation Theory |
|-----------------------------|------|------------------|-----------|--------------------------|
| 1. Evidence with imagination and creative thinking affecting scientific knowledge creation. | 2 | 17(73.91) | 1(4.43) | 5(21.73) |
| 2. Scientific knowledge inquiry approach | 5 | 5(21.73) | 5(21.73) | 13(56.52) |
| 3. Scientific knowledge creation. | 8 | 17(73.91) | 4(17.39) | 2(8.69) |
| 4. Steps of scientific methods. | 11 | 21(91.30) | 1(4.34) | 1(4.34) |

According to the analysis of data from the questionnaire, the views of nature science, among intern general science pre-service teachers as the scientific knowledge inquiry, most of them, 65.22% had the consistent views with the traditional view and 21.74% was consistent with knowledge creation and 13.04 % of the respondents was uncertain. There are several issues that are consistent with traditional views in descending order as steps of scientific methods revealed that 91.30% agreed that "Scientists have scientific knowledge by using scientific processes created by the exact sequence of experiments." The next issue, scientific knowledge creation, 73.91% of the respondents argued that "scientific knowledge is based on credible experiments.", then evidence with imagination and creative thinking affecting scientific knowledge creation showed that 73.91% agreed that "Scientists acquire scientific knowledge using scientifically proven empirical evidence derived from experiments." Moreover, there are also issues that are relevant to the theory of knowledge creation. The issue of scientific knowledge inquiry approach found that 56.52% agreed that "Scientific knowledge could be created by imagination, creative thinking and other things."
Table 3. The Nature of Science: the 3rd Aspect: The Scientific Enterprise of Intern General Science Pre-Service Teachers in each Aspect.

| Issues of Nature of Science | Item | Traditional View | Uncertain | Knowledge Creation Theory |
|------------------------------|------|------------------|-----------|--------------------------|
| 1. Collaboration of scientists. | 3    | 1(4.34)          | 6(26.08)  | 16(69.56)                |
| 2. Working for meeting the social need. | 6    | 8(34.78)         | 8(34.78)  | 7(30.43)                 |
| 3. Influence on records of scientists. | 9    | 15(65.21)        | 4(17.39)  | 4(17.39)                 |
| 4. Ethics of scientists towards experimental animals | 15   | 5(21.73)         | 7(30.43)  | 11(47.82)                |
| 5. Influence on the work of scientists. | 16   | 6(26.08)         | 2(8.69)   | 15(65.21)                |
| 6. The relationship of science, technology and society. | 18   | 3(13.04)         | 3(13.04)  | 17(73.91)                |

The analysis of data from the questionnaire indicated on the science world view among intern general science pre-service teachers in the field of science, as the scientific enterprise, 50.72 % had a view consistent with the theory of knowledge creation and 27.54 % had the consistency of the original concept and 21.04 % was uncertain. There are several issues that are consistent with the theory of knowledge creation varied from the highest level to the lowest level as the issue of the relationship of science, technology and society; 73.91 % had the same view that "Science, technology and society are related. " Aspect of collaboration of scientist, 69.56 % provided the reason that "Scientists work in the scientific community to find the best way to describe nature. They may collaborate with many parties. " The next issue is Influence on the work of scientists, 65.21 % agreed that "Scientists report the fact by virtue of prior knowledge and rationality. " In addition, there are issues that are consistent with the original idea, namely, the issue of Influence on records of scientists, 65.21 % had the view that "The scientists report the data to match the results without distortions. The former has no effect on the record of the scientist. " The next issue is that working for meeting the social need, 34.78 % argued that "Most scientists like to find and pay attention to what they like. "

7. Discussions

Based on the survey of views about the understanding of intern general science pre-service teachers, it revealed that the students had a consistent view of the theory of knowledge creation and some aspects responds to the concept of traditional view classified in each aspect of the following areas. The 1st aspect is in line with the theory of knowledge creation on scientific modelling and the persistence of scientific knowledge. But there is also a view that corresponded to the traditional one as scientific knowledge as the explanation for understanding nature with the reason that scientific knowledge is a fact that occurs in nature, is acceptable since it has been proven by the theory to explain what we have learned because knowledge is true. This view is not consistent with the nature of science view by [1] which state that scientific knowledge is a temporary reality can be changed. However, from the survey, the view of understanding the nature of science as in the 2nd aspect on scientific knowledge inquiry shows that intern general science pre-service teachers with the view that they correspond to the original idea, 91.30 % agreed that the scientists realize the knowledge using the scientific process created by the exact sequence of experiments supported by the research of [10]; the view of students in the project of promotion and science and math production is that scientific knowledge derived from scientific methods with the accurate steps respectively. Misconceptions about the nature of science [8].
state that science teachers often manage learning sequentially according to scientific methods. It understands that the scientific method is the same as the scientific inquiry and is the best approach, in line with [10] say that the scientific method is to determine the problem, data gathering, hypothesis testing, and conclusions. Furthermore, [5] who studied pre-service teachers, found that most teachers have misunderstandings that scientific method is the only way to investigate scientific knowledge. Based on science textbooks or from the form of a scientific action has a sequence of experimental methods, the steps make teachers understand that it must follow the sequence. However, scientific methods can be varied. The method is not limited to scientific methods only. The issue of scientific knowledge creation and evidence, and imagination and creative thinking that affect the scientific knowledge creation found that most students see that scientists gain scientific knowledge by using scientific processes with empirical evidence from experiments. Referring to all the data, students are given the opinion that scientific knowledge can be obtained from reliable experiments. This is in line with [6] who found that even the students as the samples in the study can be told of the conclusion of the observation. But students also focus on the experiment. This can convey that the students have a view to acquire knowledge, which emphasizes the importance of the experiment. But the truth of the scientific knowledge is not only from the experiments but is also from the observation and other information from other sources [4]. However, it can be seen that scientific experiment is not scientifically valid [13] because there are some limitations, such as time, scope of experiment or scientific inquiry and teaching and learning management using scientific evidence. It practices students to use scientific processes whether it is observation, summary, data prediction leading to the knowledge of science from the facts, principles, assumptions and rules [9]. Considering as the misunderstanding, the most important thing is to teach the teachers to have a variety of teaching strategies that encourage students to participate in group discussions with context and scientific methods. It will help students understand the issues [2] In the third aspect of science, it is found that most intern general science pre-service teachers with a view that corresponds to the theory of knowledge creation such as the issue of the relationship of science, technology and society, and the issue of the collaboration of scientists. Additionally, there are issues that are consistent with the original concept of influence on records of scientists; most of them found that scientists report data to match experimental results without distortion. The original knowledge does not affect scientists' recordings. The results of this research are essential in the production of science teachers. The intern pre-service student should gain enough experience on teaching nature of science supported by the recommendation of [1] that the teaching of nature to science is to add more experiences by teaching through science discovery.

8. Conclusions
The nature of science from both perspectives is different: the traditional concept, role of the teacher is the manager and transfer the truth of content, the scientific knowledge available to the students, contrary to the theory of knowledge creation; teachers play an important role in promoting students learn to understand science by focusing on the process of finding knowledge rather than on scientific truth. The students must manage information or experience and to create meaning of itself by providing students in the real context. In teaching and learning management, teachers must strive to create a moral and ethical environment. The students play a full role in learning by taking self and control for self-learning. The roles of the teacher are to cooperate, to facilitate and to assist students in learning. The division taking responsibility for teacher production is required to prepare and understand the nature of science for students before interning.

9. Acknowledgements
The researchers would like to express the deepest appreciation to the school administrators and mentors as well as those who are involved in all research in providing advice and guidance.
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