

***The Study of 12th Grade Student's View of Nature of Science: Classroom Action Research***

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**Abstract**

View of Nature of Science is one of crucial scientific learning goals in several countries. As in the literature, the understanding of Nature of Science can lead students to be a scientific literate persons which allow them to understand science sufficiently for making a decision in daily life. The aim of this study is to investigate student's view of Nature of Science. Thirty students participated in this preliminary study. The View of Nature of Science Two-tier Questionnaire was adapted from the Views of Nature of Science Questionnaire (VNOS-C) and was applied in this study. There are two parts in this questionnaire including rating scale and open-ended questions. The non-structured interview protocol was also used with fifteen students in order to triangulate students' view. Students' responses were categorized into 3 groups including informed, adequate and inadequate view. The study shown that there are 16.67% informed, 20.00% adequate and 63.33% inadequate. In addition, they had misconception in many aspects of NOS. The findings in this study lead to the development of learning unit concerning Nature of Science in science classroom in the second phase of this study. In conclusion, Teachers should concern about students' NOS understanding supporting. They should study on students' prior view of nature of science and learning unit should be designed based on students' prior view of nature of science.

Keywords: nature of science, NOS understanding, view of nature of science, misconception

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## Introduction

Nature of science (NOS) is known as a crucial component of scientific literacy that is a principal goal of science education in various countries around the world. (Bybee, 2008) Students cannot have science literacy without NOS view. After finishing school, Students should be able to use their NOS view to distinguish science from pseudoscience and to solve the problems with logical thinking. (Chamrat, 2009) NOS has been promoted as an important objective for science studying about 100 years. (Central Association of Science and Mathematics Teachers, 1907)

During recent years, it has been included in many national curricula such as USA ;the Next Generation Science Standards, UK; National curriculum in England, Australia; Australian Curriculum, Finland; National Core Curriculum for Preparatory Education for General Upper Secondary Education 2014, Thailand; The Basic Education Core Curriculum etc.

There are various definitions of NOS. It can be generally defined as blending aspects of social studies of science including epistemology, sociology, philosophy and history. The purpose of studying NOS is to answer the questions: What is science? How does science work? How do scientists work as a social group and how does society react to scientific enterprises? (American Association for the Advancement of Science (AAAS), 1993; Lederman, 1992; Abd-El-Khalick, Bell, & Schwartz, 2002; McComas, 2000) Aspects of NOS that are essential for student of basic education are as follow: 1) Scientific knowledge is tentative. 2) Scientific knowledge is based on empirical evidence. 3) Scientific knowledge is subjective. 4) Scientists use imagination and creativity to interpret the data. 5) Social and culture are embedded in scientific knowledge. 6) Scientific theories contrast with laws. 7) Observation is difference from inference.

There are several reasons why the nature of science is important. For instance, NOS supports student to make sense of the science, make a decision on socio-scientific issues rationally, appreciate science as a major element of contemporary culture, understand the norms of the scientific community, and learn science content successfully (Driver, Leach, Millar, & Scott, 1996)

Although it is widely claimed how NOS is essential for student to be scientific literate citizen in the future, there are students who have naïve view in all levels such as elementary, middle school, high school and higher education. (Khishfe & Abd-El-Khalick, 2002; Lin & Chiu, 2004; Khishfe, 2008; Abd-El-Khalick & Lederman, 2000) In addition, the science curriculum tends to define the meaning of NOS as only a scientific process. Science teachers process the misconception in NOS and have a difficulty in integrating NOS into science lessons. In fact, science classes are usually focused only on scientific process and content. Hence, a number of students still have naïve views. In Thailand; moreover, The Program for International Student Assessment (PISA) scores are significantly under the average scores of Organization for Economic Co-operation and Development (OECD). Nearly half of Thai students have scientific literacy in the low level which less than the basic level (level 2) compared to the standard criterion of PISA. (Institute for the Promotion of Teaching Science and Technology; IPST., 2013)

Science teachers and science educator should concern about this problem. To develop the learning unit that support student's view of NOS and integrated content is a way that can be able to improve student's view of NOS. This research is a preliminary study of the unit development. 12th grade student's views of nature of science were investigated in this study. The results in this study will be used to develop the learning unit in the second phase of the study.

### **Research question**

How did 12th grade students have view of nature of science?

### **Research purpose**

The study aims to investigate 12th grade students' view of nature of science for genetics technology learning unit creation in the future.

### **Participants**

The first researcher has chosen study participants by purposive sampling. They are 32 students of 12 th grade at a school in Bangkok, Thailand. This sampling was aimed to select major which is science-mathematics, student who take a biology course in the first semester of the academic year 2014 and students who have various academic achievement.

### **Research Design**

The study utilized a survey research design to permit the researcher to understand the participants' views of nature of science. Qualitative and quantitative approaches have been used to collect and analyze data.

### **Research Methodology**

The View of Nature of Science Two-tier Questionnaire that was adapted from the Views of Nature of Science Questionnaire (VNOS-C) and the non-structured interview protocol were conducted in order to collect students' view of nature of science. The students took 30 minutes to complete the View of Nature of Science Two-tier Questionnaire. The non-structured interview protocol was also used with fifteen students in order to verify students' view of NOS in each group.

### **Data Collection Tool**

The questionnaire was designed by researcher and analyzed validity using Index of Item-Objective Congruence (IOC) value for each questionnaire item. It was separated into two parts. The first part, general information section, aimed to examine initial data of students such as gender, age, biology term grades of academic year 2013. The remainder of the questionnaire mainly focused on investigation of students' view of nature of science and misconception. This part was two tier questionnaire, including a three-point Likert-type scale section (agree, undecided and disagree) and rationale section which let students give your opinion on the answer in the Likert-type scale section. The Likert-type scale section was developed in the following steps;

1. View of nature of science was identified by using the scope from the Basic Education Core Curriculum B.E. 2551 (Ministry of Education, 2008) that was developed by the Institute for the Promotion of Teaching Science and Technology (IPST), Ministry of Education, corresponding to NOS aspects that are useful for basic education student. (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002; McComas, 2005; Akerson & Volrich, 2006) Next, NOS aspects were chosen by content relation. The NOS aspects in the questionnaire are as follows;

- 1.1 Scientific knowledge is tentative.
- 1.2 Scientific knowledge is based on empirical evidence.
- 1.3 Scientific knowledge is subjective.
2. Items of the questionnaire were created based on students' misconception about NOS from previous research. There are 18 items which included both positive and negative items, shown in table 1.

Table 1 The items in the questionnaire

Aspects of nature of science	Number of Items	Type		No. Items
		+	-	
Tentativeness	3	✓		1, 7, 13
	3		✓	2, 8, 14
Subjectivity	3	✓		3, 9, 15
	3		✓	4, 10, 16
Empirical evidence	3	✓		5, 11, 17
	3		✓	6, 12, 18

### Data Analysis

The first step in analyzing the View of Nature of Science Two-tier Questionnaire data was interpreted by considering both Likert-type scale section and rationale section. Next, students' view of NOS was separated to be three group such as informed view , adequate view and inadequate view (Lederman, 2000) by using criterion that were as follows:

1. Informed view group was defined as the group of students who gave their opinion about NOS that were related to scientific community. Students were in this group when they choose the opinion in Likert-type scale section related to scientific community and give rationale in the same way.
2. Adequate view group was defined as the group of students who gave their opinion about NOS that were related to scientific community, but the reason didn't clear.
3. Inadequate view group was defined as the group of students who gave their opinion about NOS and shown rationale that were not related to scientific community.

After that, five students from each group were interviewed to verify that they were in true group. Percent of student in each view of NOS group was investigated.

## Results

The questionnaire were created following the structured details identified in the previous section. A validity of collected survey was analyzed using Index of Item-Objective Congruence (IOC) value for each questionnaire item. Numbers of students in each category were presented as percentage in Table 2. Regarding the percentage of the students' perception found that the percentage of the students who hold inadequate view in subjectivity aspect was highest (62.50%). The second was tentativeness aspect (26.96%). The third was the empirically based aspect (23.48%). Students who hold adequate view in tentativeness aspect was highest (25.00%). The second was empirically based aspect (15.62%). The third was subjectivity aspect (15.62%). Students who hold informed view in empirically based aspect was highest (31.25%). The second was tentativeness aspect (12.50%). The third was the empirically based aspect (6.25%).

Table 2

NOS aspects	Percent of students		
	Informed view	Adequate view	Inadequate view
Tentativeness	12.50 %	25.00%	62.50%
Subjectivity	6.25%	15.62%	78.13%
Empirically based	31.25%	18.75%	50.00%

Additionally, the section of rationale was the blank asking for reason why the students choose agreement level in the first section. The researcher looked the meaningful statements in their responses to the rationale part, code them, and put them into categories. Finally, students' misconception about NOS that needs to improve were investigated. The students' responses indicate that they hold misconception in NOS aspect such as tentativeness, subjectivity and empirically based, and they were familiar with cookbook lab. Some direct quotes of the students' answers from the questionnaires were as follow:

### Inadequate view

"It's in the book that was proved, so it's always true.

Student# I

"It's law that means the verified knowledge. Therefore, it cannot change."

Student# II

"Scientist use only scientific principle when they interpret the result of experiment."

Student# III

"The cloud model is the best atom representation forever because it constructed based on the experiment in the past."

Student# IV

According to the answer, some student thinks that the scientific knowledge became a law when the knowledge was proved several time. Therefore, it cannot change.

### Informed view

“If there is new experiment finding in the future that is different from the law, the laws may change.

Student# V

“The scientist should show the evidence that support the situation. It will be trust.”

Student# VI

“Scientists try to interpret data from experiment by using prior knowledge.”

Student# VII

“We should check the resource of disaster warning in social media to verify the data. It may just be rumor which is not supported by the evidences.”

Student# VIII

According to the answer, some student has view of NOS that relate to scientific community.

### **Conclusion and Discussion**

This research aims to study 12 th grade students' view of nature of science in a school, Bangkok, Thailand. According to the questionnaire result, the most of student hold inadequate view in aspects such as tentativeness, subjectivity, empirically based. In addition, they had misconception in aspects of NOS. For example, knowledge become law, law cannot change, scientist use only scientific principle in experiment interpretation, scientist's word is always trust. All these results correspond to the researches and studies from Thailand and other countries. In Thailand, Pattamapongsa (2012) studied high school students' view of NOS in photosynthesis content. The results found that there are many students had the misconception in several NOS aspect . In addition, Mahalee and Faikhamta (2010) used an open-ended questionnaire and semi-structured interview to study seventh grade students' view of NOS. The result shown that a number of student more than 50% had misconception and didn't understand NOS. Moreover, the researches from other countries had revealed the results in the same way. Kang, Scharmann and Noh (2005) investigated students' views on nature of science in Korea. The result shown that student in 6th, 8th, and 10th grade still need further development of their views on the NOS.

### **Implication**

Nature of science is an important part of scientific literacy; however, the research indicates that there are a lot of students who didn't have view of NOS that related to scientific community. Therefore, it leads to the development of learning unit concerning nature of science in science classroom. Science teacher should focus on students' prior view of nature of science and create learning unit based on students' prior view of nature of science.

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