Explicit Nature of Science in the STS Contact Lens “Big Eyes” Unit

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Abstract. This paper aimed to explain Grade 11 students’ view of nature of science (NOS) in the STS contact lens “big eyes” unit and explicit NOS. The STS contact lens “big eyes” provided students to learn about refraction, thin lens, eyes and vision through science technology and society (STS) approach and learning activities of explicit NOS. Participants included 15 Grade 11 students who study in Kaewsadet school, Kalasin, 2nd semester, academic year of 2011. Students’ views of NOS were interpreted through students’ responses in learning activities of explicit NOS, participant observation, journal writing, and interviewing. Students’ responses were categorized regarding 8 aspects of NOS. These 8 aspects included (1) scientific knowledge demands evidences; (2) tentativeness of scientific knowledge; (3) laws and theories; (4) scientific methods (no universal scientific method); (5) subjective in that science is a human endeavor and investigations are conducted within the context of particular theoretical frameworks; (6) partly the product of inference, imagination, and creativity; (7) socially and culturally embedded (can be influenced by contextual factors outside of the scientific community); and (8) developed from a combination of observation and inferences. The paper will discuss students’ views of NOS that were showed in explicit NOS activities of the STS contact lens “big eyes unit. This paper has implications for enhancing students’ understanding of NOS in Thailand

1. Introduction

Present science education around the world have made significant contributions to the understanding of the nature of science. And present in the core curriculum of basic education in 2008 AD, the nature of science and technology learning at 8 by the standards of learning that Students will be able to use the scientific and spiritual science in the quest for knowledge to solve problems as a natural phenomenon that occurs mainly in the form that it can describe and verify the information and tools that are available in during that time. Understand that science, technology, society and environment. With their relationships. The Institute for the Promotion of Teaching Science and Technology [8] Science and Technology has set standards that teachers must first understand the nature of science and technology. The process of inquiry and problem solving. They can apply their knowledge to create learning experiences that make subject matter meaningful to students. Therefore, many countries have focused on identifying the nature of science in education. Due to the nature of science, which is a key component of learning science. It allows individuals to seek self-knowledge. Learning throughout life. Can think of. Think creatively. Solve problems in a systematic manner. And led to the creation of new knowledge that is grounded in social development. Especially in the economic competition between
the countries. Manufacturers must have the ability in science. Employees must be skilled. Have a good understanding and ability in science that meet the needs of the country. (Yuenyong & Narjaikaew, 2009) To understand the nature of the science of the people, everyone is important. And to increase the competitiveness of the global economy. Researchers have commented that the teaching of science to promote an understanding of the nature of the science curriculum is a curriculum based on science, technology and society (STS). The teaching of science by Science. Technology and society. Is the integration of teaching science and related science context. Technology and society. Promote the development of scientific knowledge. Due to the nature of science is developed through a process of social processes and the findings of scientists and scientific knowledge is public knowledge, reliable and have references. But the quest to develop the scientific knowledge shows that science has changed. Of scientific knowledge is reliable knowledge over time. This is not a real-time. But that has changed scientists. Examine and develop additional knowledge and credibility. The phenomenon can be explained with the changes [12]. The concept of learning by using technology and social sciences to the curriculum that emphasizes real-world experience for students [4]. Focusing on problems and issues in the main. Encourage students to apply scientific knowledge and technological applications in accordance with their context. The initial implementation issues related to science and technology, the actual. Instead of teaching the concepts and processes. Encourage students to think critically and apply the concepts in real situations. Students can link classroom learning with real-life situations. The local context of the learner. (Wilson & Livingston, 1996, referred to in [7]) The teaching of science concepts. Technology and society. This approach encourages students to use inquiry process. Using science and technology issues related to the actual context of the society. A catalyst for students interested in learning content. And encourage students to share learning activities and learning about the inquiry process. e process of learning by discovery of knowledge related to social issues. The understanding of the nature of scientific knowledge through the process of the quest to understand the nature of the social world, which makes the students understand the nature of science as well.

Learning based on science, technology and society, the concept of Yuenyong (2006) [9], with social issues. Technological and social context. To encourage students to learn. The students have the opportunity to use their own ideas and creative concepts to explore the knowledge associated with prior knowledge. Learning theory of Constructivism. Of development. Or change existing ideas of the students. The conversion concept is to create and accept new ideas. Or the structure of the original idea that is new. Students to generate ideas, rather than absorb new ideas. To fill the empty brains of students to the full. Or not the acquisition of the new ideas of the students. But who is the creator of your own knowledge [6]. Gives students the knowledge and skill quest information. Students can study the self. The process can be applied in everyday life. Learning based on science, technology and society, the concept of Yuenyong (2006) is the one that will help the students understand the nature of science. The learning efficiency. I can bring that knowledge to solving problems is to live appropriately in line with economic conditions. Society and culture.

For learning themes. In physics. The Grade 11. For learning about contact lens “big eyes” unit in physics. The Grade 5. The purpose of learning so that students understand and can explain the refractive lens of the eye and some vision. The contact lens is critical to human life. To be utilized in the visible. Contact lenses is associated with the daily lives of people from past to present. The use of contact lenses is what is happening in society. The science and technology and other facilities. And meet human needs. But teaching is the knowledge of the refractive lens of the eye and some vision. In human terms that do not involve the determination of the latent image object distance and focus distance learning students do not understand why they need to learn about some of the refractive lens of the eye and vision. In addition to learning to solve problems that can score. Score, which is due to a lack of awareness of the relationship between science and technology influence each other. Teachers and students were not aware of the importance of learning the nature of science. Students lack an understanding of the nature of science. Learning and teaching in the refractive lens of the eye and some vision. The goal should be to help the students understand about refractive lens of the eye and
some vision. Associated with the daily lives of students, Promote and develop an understanding of the nature of the science of learning. The students in Science, Technology and Society. This is another way to help students enhance their knowledge on their own. Presented their ideas properly. The knowledge used in the appropriate context. And thinking skills. Classified as critical thinking, reasoning with a difference. The conclusions and decisions. The relationship between science and recognizing. Technology and society. Environment in terms of influence and impact each other. Science is a spiritual virtue. Good ethics [10]. Understanding of all aspects of Scientific Literacy, This includes understanding the nature of science and Science Knowledge and Habits of Mind. They can bring knowledge to solve the problem. Application of scientific knowledge about the social, technological, economic and cultural environment. The aim of science education in Thailand. Lead to the development of national social and economic development to expand the group next.

In the past decade, scientists have studied the nature of scientific research and understanding of teachers and students, the teachers and students understand the nature of science. In particular, the lack of scientific understanding of the nature of science teachers, science and the resulting impact on student learning is the students' understanding of the nature of scientific error. Teaching science is often little connection with reality. And they are of the view that scientists must strictly adhere to the scientific approach to the knowledge of the truth does not change. Knowledge and understanding that the theory is not proven and that the rule is exact and accurate. Many students do not see the connection between what they learn in science class and what students know about the real world. (Bell, n.d.) For a study on the nature of science is the study and understanding of the nature of science teachers only. A study to develop in students the nature of science. In order to promote understanding of the nature of scientific knowledge that can allow people to develop an understanding of the nature of science to students. According to the study of the core curriculum of basic education, BE 2008. The scientific study of the proposed solutions. And the nature of scientific knowledge in a variety of methods such as case studies. Role-plays. The inquiry. Field of the debate, etc. These are the basic principles of the technique. "The contextual and pointed out" the nature of scientific knowledge should not be separated. It should be integrated with scientific knowledge, in different and emphasize with the students the opportunity to comment on the nature of science. (McComas, 2004 referred to in [5] The nature of science learning that, Learning the nature of science explicit. The learning activities and experiences with respect to the nature of science and allows learners to understand. Discussion by asking about the nature or the nature of science is clearly in the lesson. Therefore, the nature of science teaching and learning about science, to develop a better understanding of the nature and the scientific method. And the relationship between science and society. Should be learning by pointing out the importance of the issues about the nature of science and learning that emphasizes explicit [2].

This study is intended to be Grade 11 students’ view of nature of science (NOS) in the STS contact lens “big eyes” unit and explicit NOS. To guide the development of teaching natural science, especially physics and the next.

2. Methodology
This research was conducted as a Mixed Method for the Interpretive Paradigm for the purpose Grade 11 students’ view of nature of science (NOS) in the STS contact lens “big eyes” unit and explicit NOS.

2.1. Participants
Participants included 15 Grade 11 students who study in Kaewsadet school, Kalasin, 2nd semester, academic year of 2011.

2.2. Methods
Grade 11 students’ view of nature of science (NOS) in the STS contact lens “big eyes” unit and explicit NOS. Students will experience learning about the nature of science that allows learners to understand the nature of science by asking questions and discussions about the nature or presentations
nature of science explicit. Also allows students to understand the nature of science. For the activity. Figure 1 to understand the nature of science students on the 4 (NOS 4) for a variety of methods of scientific inquiry. The students were asked their opinion and the opinion of the class. The methods of scientific inquiry, each with a different opinion. Shows that a wide range of scientific inquiry.

Figure 1. indicates the nature of science to Article 4.

Figure 2a to 2b shows an understanding of the nature of science students, the 2 (NOS 2) Scientific knowledge can be changed. If there is evidence or reliable information and support, Article 3 (NOS 3) laws and theories as scientific knowledge is different, Article 6 (NOS 6) creativity and imagination, the role of scientific inquiry. Article 8 (NOS 8) the science dealing with human beings, which are influenced by society and culture. Students learn about history by studying the light of scientific knowledge in order to show students that the Science and background of the development until the discovery of new knowledge as a reason. And help students understand the importance of creativity that led scientists to discover new knowledge. It helps students recognize and understand the science content knowledge better, too.
Scientists named the Persian Hasan light of his knowledge of the theories of Greek philosophers as well. Until can understand the process are achieved. But to succeed, he must struggle with the idea too, because he was incarcerated on charges of scheme to divert the water into energy. During my 10 years in prison, he saw the difference between darkness and light. He saw the error of the theoretical properties that help clean the object with a light shot out from the eye to the object. He noted that due to the glare of light. He is very keen eye. The light entering the eye is not ejected from the eye. He described the nature of the light beam is focused by simulating the light from the light source to the object and then reflected into our eyes. A clear example is the reflectivity of the mirror symmetry is that the beam is incident on the beam. Angle of incidence equals angle of reflection. The very clever of him. He therefore concluded that the incident light is reflected into the eye, we all know that not only is the glass. He and we also developed his theory to the theory of reflection and refraction of light.

Figure 2a indicates the nature of scientific activity, the 2, 3, 6 and 8.
In addition, after teaching a lesson plan, students must reflect a student’s notes about the incident to express their own feelings and experiences. The normal operation of the daily diary The students analyze the text of the interpretive understanding of the nature of scientific theory as a framework for the analysis of students’ understanding of the nature of science.

After learning of the concept of science technology and society Yuenyong (2006) and indicate the nature of science, the Contact Lens “Big Eyes” Unit. Focus Group Interviews Academy students will be working together. To better understand the issues that students are not as detailed. Information is not clear. The conclusion is not. After removing the tape recordings and images from a video camera during the course. The text of the Journal and to the interpretation of the data analysis to understand the nature of science as a theoretical framework to analyze and understand the nature of science students.

3. Findings and discussion
The research this time is Grade 11 students’ view of nature of science (NOS) in the STS contact lens “big eyes” unit and explicit NOS, 8 issues. On the Nature of Science 1 (NOS 1) The scientific study of natural phenomena. This requires evidence through critical thinking and rationality. On the Nature of Science 2 (NOS 2) scientific knowledge is subject to change. If there is evidence or reliable information and support. On the Nature of Science 3 (NOS 3) laws and theories as scientific

Figure 2b. indicates the nature of scientific activity, the 2, 3, 6 and 8.
knowledge is different. On the Nature of Science 4 (NOS 4) for a variety of methods of scientific inquiry. On the Nature of Science 5 (NOS 5) the science by inquiry, observation and inference are different. Observations provide evidence for the inference. Scientific knowledge and the inference from the evidence obtained by observation. On the Nature of Science 6 (NOS 6) creativity and imagination, the role of scientific inquiry. On the Nature of Science 7 (NOS 7) Science is a human activity that is directed or guided by theory, practice and experience the emotions of people. And the nature of science, the 8 (NOS 8) The science dealing with human beings, which are influenced by society and culture. Based on an analysis of the nature of science students. Analysis of the data can be displayed as shown in Table 1.

Table 1. shows the frequency and percentage of students' understanding of the nature of scientific knowledge in the contact lens “big eyes”

| STS approach | nature of science | The behavior of the students' understanding of NOS. | Frequency | Percent |
|--------------|-------------------|---------------------------------------------------|-----------|---------|
|              |                   | The activity | Diary | Observation | And frequency |         |
| Identification of Social Issues Stage | NOS 1 | 8 | - | - | 8 | 23.53 |
|              | NOS 8 | 15 | 11 | - | 26 | 76.47 |
| Identification of Potential Solutions Stage | NOS 1 | 7 | - | - | 7 | 6.14 |
|              | NOS 4 | 15 | 1 | 15 | 31 | 27.19 |
|              | NOS 6 | 15 | 1 | 15 | 31 | 27.19 |
|              | NOS 7 | 4 | - | 15 | 19 | 16.67 |
|              | NOS 8 | 15 | 11 | - | 26 | 22.81 |
| Need for Knowledge Stage | NOS 1 | 45 | 2 | 18 | 65 | 33.85 |
|              | NOS 2 | 13 | 1 | - | 14 | 7.29 |
|              | NOS 3 | 15 | - | - | 14 | 7.29 |
|              | NOS 5 | 15 | - | - | 15 | 7.81 |
|              | NOS 6 | 15 | 2 | 3 | 20 | 10.42 |
|              | NOS 7 | 15 | - | 4 | 19 | 9.90 |
|              | NOS 8 | 30 | 12 | 3 | 45 | 23.44 |
| Decision-Making Stage | NOS 6 | 15 | - | - | 15 | 16.67 |
|              | NOS 7 | 15 | - | - | 15 | 16.67 |
|              | NOS 8 | 60 | - | - | 60 | 66.67 |
| Socialization Stage | NOS 8 | 15 | - | - | 15 | 100.00 |

Table 1 shows that learning about themes. The teaching model based on science. Technology and Society (STS) and indicate the nature of science. To promote understanding of the nature of science students in the eight issues, which they have expressed opinions on the nature of science as well as 8 points to the following description.

Students commented on NOS 1 that scientific research is looking at reliability. Because every time they try to take notes to use as a reference a proof. The students' answers to the following.
"All the scientific knowledge acquired in the experiment, the experimental device. The experiment. The results of the experiment. And the time is recorded as a reference" (S8)

"Why is the scientific study of the experimental observation that the test to find out" (S1)

Students commented on NOS 2 is that the scientific literature on this subject to change at any time. Some other scientists are discovering new knowledge to prior knowledge or refute the inquiry was to
modify the original knowledge. If there is evidence or reliable information and support. The students' answers to the following.

"The science has changed. They are subject to change at all. Some other scientists have discovered that the new knowledge or new knowledge or the knowledge that has ever been discovered. I could not find any that may be more realistic "(S3)

"The science has changed. Because scientific knowledge is subject to change if new evidence or reliable information to support "(S9)

Students commented on NOS 3 that the rules are more reliable than theory. The theory can be changed rather than the rule. But they still can not explain what happened to the laws and theories. Related or not. And equally important, or not. The analysis of students' answers to the quoted text of statement. Substantive understanding of the nature of science. The orientation of the student teachers. In preparation for data collection, the "laws and theories are different. This rule describes the phenomenon that occurs as a formal condition for any theory or explanation of the reasons for the phenomenon that occurs with conventional "(S2)

Students commented on NOS 4 into a scientific inquiry should investigate a variety of methods. In order to get reliable information on various surveys, such as searching for observation and experimentation. This is the quest that will take any appropriate way according to each one. The students' answers to the following.

"Everyone has a different opinion to help make it more intimate. And thus we see the intent of the design specs of the invention "(S14)

"There are many ways to find answers. You can find answers to many of the experiments and observations "(S7)

Students commented on the observation that NOS 5 and the sequence or to a different conclusion. This observation is to monitor and record what happens. The data obtained from observation into a conclusion that is different so that the observations and conclusions are related to each other. The students' answers to the following.

"The observations and conclusions differ. It is a way of looking at the object it is. The conclusion section summarizes the results we obtained from the various trials "(S2)

"The observations and conclusions differ. The observation Is to look at things around us as a concept. The conclusion is to collect all the information to be conclusive "(S9)

Students commented on the NOS 6 that creativity and imagination are essential to the design work of students. Similarly, scientists at the creativity and imagination are essential to the design method. The students' answers to the following.

"Scientists must design the experiment. The need for creativity. Because it may lead to new knowledge of how many scientists, since each person may experience the same "(S8)

"Outhasan is a wise observation, thinking I do not have the imagination" (S3)

Students commented on the inquiry as to NOS 7. Design work. And the interpretation of experimental results with a variety of ways. Due to the interest of each individual is different. And when the scientists who have studied in the same conclusions. Conclusions from the research may be different. The scientists have their own ideas. There are different methods. Are different, it is subjective in that the scientists have to work in science. The students' answers to the following.

"The water is predicted to be light because of a prophecy in mind, each with a different answer is to get out" (S6)

"Prediction of mechanical science. Water and light are the only people that it is not the same "(S9)

Students commented on the NOS 8 that science and technology are related by a relationship as a link. The technology must have the knowledge to know the scientific and social values. To develop technologies that benefit the people. Do not make trouble for the society. Because scientific knowledge is not power that can do just about anything. Not above the society and culture. Have not taken advantage of society and humanity. Scientific knowledge and scientific inventions. Scientists have researched it a society. The students' answers to the following.
"Science is a part of society and culture. The science and technology. Facilities. The penalty is both useful and interesting. The people are so used various technologies to facilitate their own. But some of them may be used in the production of scientific technology in the wrong way. So science is a part of society and social values "(S3).

"Science does not transcend national and cultural. The story of how scientists make discoveries. I need to get from the national. Religion and culture before. If not, they will be punished by a prison "(S9)

So from the above analysis to understand the nature of science. Students can express their views about the nature of science appropriately. The activities of Learning contact lens "big eyes" By Science Technology and Society (STS) and indicate the nature of science. To promote development of natural science to the students as well.

4. Conclusion
Form grade 11 students’ view of nature of science (NOS) in the STS contact lens “big eyes” unit and explicit NOS. The results showed that Students understand the principles and concepts underlying scientific evidence for a reasonable principle. And scientific knowledge can change as a reliable supporting evidence. But understanding the nature of scientific laws and theories of the students are not able to explain the importance of the opinion that the rule, but they are more reliable than theory. The theory is likely to change than laws. For scientific inquiry, students can propose a variety of research knowledge. The scientific quest to understand a variety of ways, such as the search for treatment or observation. The data from the observed data to infer the evidence. The scientific experiments. Scientists have designed an experiment with their creativity and imagination in the design plan. The creativity and imagination are vital to scientific inquiry. The students also have an understanding of the learning experience of science, belief, or social and cultural influence on science. The learning experience ideas or beliefs of scientists. As a result, the conclusions of scientific knowledge is subjective. The social and cultural. Students understand that technology is designed to use scientific knowledge and social needs into the design. These technologies can be developed which scientific knowledge has progressed further. However, science or technology. Must be accepted by society to be reliable and do not affect the hardship to society. Thus, society and culture is essential to the development of knowledge in science and technology.

The curriculum is grade 11 students' view of nature of science (NOS) in the STS contact lens "big eyes” unit and explicit NOS. Can promote development of students' understanding of the nature of science as well.

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References
[1] Attapan N 2012 The Study of Grade 11 Students’ Understanding in Learning about Lights through Science Technology and Society (STS) Approach and Explicit NOS (Master of Education Thesis in Science Education, Graduate School, Khon Kaen University)
[2] Kaewnan C 2009 Effects of Science Teachers’ Understanding and Learning Management of the Nature of Science on Understanding of the Nature of Science of Mathayomsuksa One Students in Basic Educational Extending Opportunity School (Master of Education Thesis in Science Education, Graduate School, Prince of Songkla University)
[3] Meesri S 2007 “A Development of Professional Development Program for Enhancing Teachers’ Understanding of the Nature of Science and Its Implementation in the Classroom” (Doctor of Education Thesis in Science Education, Srinakharinwirot University)
[4] National Science Teacher Association [NSTA] 1993 Science/Technology/Society As Reform in
Science Education. (New York: State University of New York Press) pp 3-13

[5] Pongsophon P 2009 Science teaching As science (As a science vol 63) chapter 1 pp 84-89

[6] Randy L. Bell PH D (n d) Teaching the Nature of Science Three Critical Questions (Best Practices in Science Education)

[7] Sonsanam O 2010 Enhancing Grade 12 students’ Everyday Life Problem Solving Ability and Learning Achievement on Human and Sustainable Environment through Science Technology and Society (STS) Theme (Master of Education Thesis in Science Education, Graduate School, Khon Kaen University)

[8] The Institute for the Promotion of Teaching Science and Technology [PIST] 2002 Science and technology standards (Bangkok: Printing krurusapa Ladprao)

[9] Yuenyong C 2006 Teaching and Learning about Energy : Using STS approach (Doctor of Education Thesis in Science Education, Graduate School, Kasetsart University)

[10] Yuenyong C 2007 Since the concept of human life in science, technology and social learning in science can find (Journal of Basic Education Commission. Ministry of Education vol 10) chapter 2 pp 29-34

[11] Yuenyong C & Narjaikaew P 2009 Science Literacy and Thailand Science Education (International Journal of Environmental and Science Education, July) pp 335-349

[12] Yuenyong C & Sumranwanich W 2009 Teaching of Science, Technology and Society Khon Kaen : Department of Science Education (Faculty of Education Khon Kaen University)