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ENHANCING UNDERSTANDING ABOUT THE NATURE OF LOCAL SCIENCE: AN ACTION RESEARCH IN PRIMARY EDUCATION

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Abstract

Through local scientific learning, this action research attempts to improve primary school students' understanding of the nature of science. The target group consisted of nine grade 6 students from a school in Thailand's northeast. The observational tools were the understanding of nature of science test, understanding of nature of science questionnaire test, and interviewing. The research tools were action plans based on local science and observational tools were 1the understanding of nature of science test, understanding of nature of science questionnaire test, and interviewing. Mean, standard deviation, and percentage were used as descriptive statistics. According to the data, students improved their knowledge of science by 62.96 percent after the first learning cycle. Students achieved 92.59 percent of their grasp of science during the second learning cycle. Qualitative data could be used to help future research discussions.

Keywords: Local science, nature of science, primary science, traditional science.

INTRODUCTION

Since it has an impact on everyone's everyday activities and employment, science plays a significant part in daily life. In order to simplify their lives and work, humans use a range of tools, combining scientific knowledge with creativity and other efforts (Tortorella et al., 2021). Science may help people strengthen their reasoning, creativity, analytical skills, and critical thinking (Darling-Hammond et al., 2020). It also helps people to learn, approach problems in a methodical way, and base conclusions on a range of facts and verifiable evidence. It is a byproduct of modern civilization as well.

As a consequence, everyone ought to study science. One goal of science education is to develop students into scientifically literate people who can derive ideas and information from the results of experiments, as well as acquire processes and knowledge through observations, surveys, investigations, and experiments (Olson, 2018; McComas & Clough, 2020). A person who is scientifically literate may use scientific methods and knowledge to do research, provide views, make judgments, answer probing questions, and explain events (National Research Council, 1996). A person who is scientifically literate must be capable of understanding not just scientific content but also scientific techniques, nature, and restrictions (Nuangchalerm, 2009).

While science has provided mankind with an astounding level of technical prowess and a wonderful comprehension of nature, it has also muffled and even endangered other cultural ideas and values via local and global understandings. There is a growing understanding that the multiplicity of knowledge systems demands respect; some people refer to them as alternative information banks in the language

of conservation. One of many is the scientific viewpoint. Many of the local scientific and cultural practices that were earlier considered to be "primitive" and in need of development are now abundantly shown to be sound. However, this study goes beyond establishing the reliability of local science and supporting the use of outside information in development to make the case that we should question the underlying assumptions of science and continue to fight its hegemony.

For learners to become scientifically literate people, it is necessary for them to acquire scientific understandings. Three concepts make up the conceptual foundation for scientific literacy: the nature of science, scientific principles, and scientific ethics, all of which students may meet in the future. These are actual problems that people in science, society, and individuals deal with every day (Roberts, 2007). Science education should stress the essence of science by concentrating on the connections between science and modern society. The texts also amply demonstrated the connection between scientific literacy and the nature of science. Scientific viewpoints that hold that science is not independent and objective but rather is impacted by people and society are necessary for scientific literacy (American Association for the Advancement of Science, 1994; Abd-El-Khalick & Lederman, 2000; Holbrook & Rannikmae, 2007; Callahan, 2009).

This idea is in line with that of Clough (2011), Häyrynen et al. (2021), and Parmiti et al. (2021) claimed that the nature of science supports science education by enabling students to recognize the value of scientific discoveries and by enhancing their understanding of the fundamentals, the advantages, the drawbacks, and the social roles played by science as well as the operational procedures of scientists. The shift to sustainability depends on environmental citizenship as a force for transformation. According to our point of view, a contextual resource doctrine offers a framework for people's environmental values, which includes both the ability to adhere to the doctrine's standards and the capability to critically evaluate them using reasonable and scientific reasoning. Therefore, it is important to emphasize location-specificity and feeling of place in civic science teaching. These may help students grasp scientific ideas, make them aware of the value of science, and serve as the most fundamental building blocks for understanding the sources of scientific information (Bell, 2008).

Although educating the students to understand the nature of science is a goal of Thailand's education, there are problems about teaching the nature of science. Since the teachers considered that teaching the students to understand the nature of science was difficult and the education did not focus on learning the nature of science by using teaching materials, these were the causes of the misunderstandings. The educational institution that had close relationships with the family institution and the religious institution that develop the young people's ethics and knowledge for living with others in the societies focus on academic certificates instead of applicable knowledge (McComas, 2020). The education emphasizes on memories instead of understandings and applications. It is not connected to the lives of the people in the societies (Hillen, 2020).

Consequently, the communities did not transfer wisdoms because the education did not include the local wisdoms in order to make the young people proud of the wisdoms and their cultures. To explain the things or phenomena about the people's lives in local areas with scientific knowledge surrounding us, we must study science in order to adapt ourself to the situations in the areas. This is considered as the origin of local science. Regarding the education with the local science, the students must practice or interact with environments. The contents must be the local contents that are consistent with the basic education curriculum instead of the other contents from other areas because the other contents will not be applied and meaningful to their lives (Gandolfi, 2021). The drivers of the education with the local science that cooperate with the teachers are local philosophers who have experiences. For this education, the students will achieve the goals of the curriculum and learn with their parents and local elders. They will love, understand, protect and improve their local areas with virtues.

American Association for the Advancement of Science [AAAS] (1990) explaining that the framework of the nature of science consisted of various concepts that could be classified into three main groups: the scientific world view, the scientific inquiry, and the scientific enterprise. It covered and consistent

with the education about the nature of science. Hence, it was used as the conceptual framework for developing the research instruments for the students' understandings about the nature of science. This study aims to enhance understandings about the nature of science for the grade 6 students being educated about the local science.

Problem Statement

The relationship between indigenous, local, and scientific knowledge systems has received a lot of attention over the last several decades, notably in the domains of ecology and natural resource management. With a focus on effective communication between members of various communities and cultures, we evaluate the body of literature in this monograph to develop a practical framework for the representation of knowledge systems in general (Parmin et al., 2019; El Islami & Nuangchalerm, 2020; Wheeler & Root-Bernstein, 2020; Tengö et al., 2021; Phoopanna & Nuangchalerm, 2022). In order to show existing and potential applications of the knowledge paradigm, we include these essential concepts into a wide framework for operationally characterizing local scientific knowledge as an important advance in the ecology and natural resource management literature.

We concentrate on offering succinct, actionable definitions and explanations of the core ideas pertaining to information, knowledge, wisdom, and data. We evaluate previous uses of sociocultural knowledge system thinking, concentrating on system structure and function, as these concepts become more clear. We identified a set of core knowledge system functions and actor roles that are common across several academic fields. Even if each story has some truth, they all contradict one another and are completely inadequate (Bush & Doyon, 2019; Frantzeskaki et al., 2019; Marginson, 2022).

Particularly in light of the extremely ambiguous global future of ecology and natural resource management, members of various knowledge systems engage in reciprocal and meaningful discussion with representatives of local science and global scientific knowledge. The findings would be advantageous for the educational activities conducted by scientific instructors and employed as instruments for molding students into persons who can successfully use knowledge in the learning societies of the twenty-first century. Furthermore, the outcomes may serve as guidance for science instructors or those in charge of creating student-friendly scientific curricula to improve learning activities.

METHOD

Research Model

This study employed action research method (Figure 1) in order to enhance the understanding about the nature of science for the Grade 6 students being educated with the local science. The digestive system was significant topic in local community. School area located in northeast of Thailand, rich and entire years of cultural sustaining.

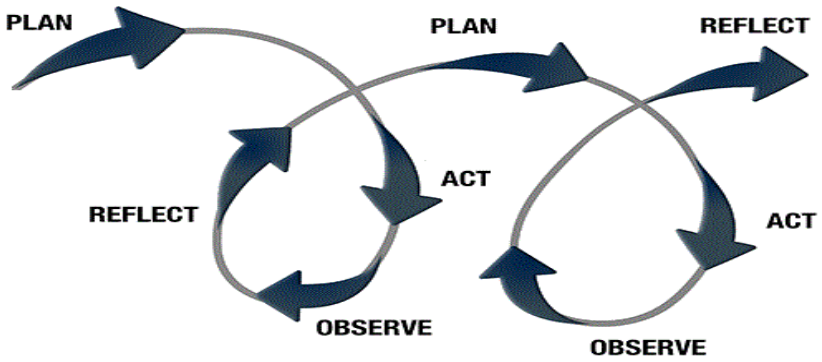

Figure 1. Action research

Target group

This study employed and action research to investigate understanding about nature of science. Nine of Grade 6 students as target group, they were studying science in the academic year of 2021. The target group was purposive selection due to whole class required enhancing understanding about nature of science. The school context, small school-sized elementary level where located in the northeast of Thailand. Learning resources about local knowledge and scientific knowledge claimed that rich and concerns local culture, science can be incorporated into school curriculum, and nature of learners' learning can be developed.

Research Instruments

The research instruments were the two operational plans using the local science as an innovative lesson plan. The data collection instruments were the two sets of the writing tests about the understandings of the nature of science. Each set had three items, the evaluation form about the understandings of the nature of science with the five-point rating scale and 12 items, and the interview form about the education with the local science. The research instruments were validated by 3 experts in each cycle. The index of consistency was reported ranges between .67-1.00 with qualitative comments. Then, authors revised and corrected its appropriateness before collecting data and made its reflection.

Data Collection

The action research employed 2 cycles by each cycle can be procedure with planning, acting, observing, and reflecting. The details in each cycle can be shown as in Table 1.

Table 1. Details of action research

	Cycle 1	Cycle 2
Planning	The documents and research studies about the nature of science were studied in order to create the data collection instruments, including the six educational plans with the local science about foods and digestive system. Each plan took two hours, the total time period was 12 hours. Two sets of the tests about the understandings of the nature of science, each set had three items. The evaluation form with the five-point rating scale and 12 items, and the interview form about the education with the local science.	The plan for enhancing understanding about nature of science were made and the teaching were revised and improved according to the analysis results and the summary understanding about nature of science from the cycle 1. The reflection can as a primary source of lesson plan design. Each plan took two hours, the total time period was 12 hours. The evaluation form with the five-point rating scale and 12 items, and the interview form about the education with the local science use for discussion and plan in the current cycle.
Acting	The learning activities were conducted according to the 1st – 3rd lesson plans. After the activity periods were completed with local science learning organization, teachers and the students had to discuss about the problems and the obstacles in the learning activities.	The learning activities were conducted according to the 4th - 6th lesson plans. After the learning activities were completed, teachers and students had to discuss about the problems and the obstacles in the activities. The suitable ways in the process of scaffolding their understanding about nature of science performed.
Observing	The observation tool and techniques were used in order to observe the students' understanding about of the nature of science, the operations and discussions were implemented. The questionnaires and the interviews about the understanding were used.	The observation tool and techniques were used for observing the students' understandings about the nature of science, operations and discussions. The evaluation form and the interview form for the understandings about the nature of science were used.
Reflecting	The results from evaluating the learning activities with the local science were used by the researchers for analyzing, explaining, and reflecting the evaluation results and the summaries in order to improve the learning activity plan in the cycle 2.	The results from evaluating the learning activities for developing the understanding about the nature of science according to the scientific, technological, social, and environmental concepts from the observation. Data collection and analysis were used for reflection.

Data Analysis

The data analysis of this study used the basic statistics including percentage, mean and standard deviation, and it was compared to the specified criteria. However, the understanding about nature of science can be interpreted through the procedure of action plan and its reflection in each cycle.

RESULT AND DISCUSSION

By empirical data, it can be considered that there were the students who did not pass the criteria for developing the understandings of the nature of science by criteria of 70% in the following aspects: there were 9 students in the aspect of the scientific worldview, 7 students in the aspect of scientific inquiry, and 7 students in the aspect of scientific enterprise (Table 2).

Table 2. Understanding about the nature of science in Cycle 1

Student	Nature of science						Total (9)	%	Understanding Level	
	Scientific worldview		Scientific inquiry		Scientific enterprise					
	Total score (3)	%	Total score (3)	%	Total score (3)	%			Mean	Interpretation
1	1	33.33	2	66.67	2	66.67	5	55.56	2.78	Moderate
2	2	66.67	3	100	3	100	8	88.89	4.44	High
3	1	33.33	1	33.33	1	33.33	3	33.33	1.67	Low
4	2	66.67	2	66.67	2	66.67	6	66.67	3.33	Moderate
5	2	66.67	2	66.67	2	66.67	6	66.67	3.33	Moderate
6	2	66.67	3	100	3	100	8	88.89	4.44	High
7	2	66.67	2	66.67	2	66.67	6	66.67	3.33	Moderate
8	1	33.33	1	33.33	2	66.67	4	44.44	2.22	Low
9	1	33.33	2	66.67	2	66.67	5	55.56	2.78	Moderate
Mean	1.56	51.85	2.00	66.67	2.11	70.37	5.67	62.96	3.15	Moderate
Std.Dev.	.50		.67		.57		1.56			

According to Table 2, it was found that the mean score for the understanding about the nature of science in the three aspects was 62.96%. The scores in each aspect were as follows: the score of the understandings of the nature of science especially scientific worldview was 51.82%, the score for scientific inquiry was 66.67%, and the score of the scientific enterprise was 70.37%. The reflection in the Cycle 1 can be used for discussion, it can be considered that all students pass the criteria 70% of understanding about nature of science through local science learning as well (Table 2). Students no. 2 and 6 showed their level of understanding nature of science were at high level, so the other students should be developed their learning and understanding more level. The Cycle 2 was established and conducted, level of understanding in the next Cycle can be shown in Table 3.

Table 3. Understanding about the nature of science in Cycle 2

Student	Nature of science						Total (9)	%	Understanding Level	
	Scientific worldview		Scientific inquiry		Scientific enterprise					
	Total score (3)	%	Total score (3)	%	Total score (3)	%			Mean	Interpretation
1	2	66.67	3	100	3	100	8	88.89	4.44	High
2	3	100	3	100	3	100	9	100.00	5.00	Highest
3	2	66.67	2	66.67	3	100	7	77.78	3.89	High
4	3	100	3	100	3	100	9	100.00	5.00	Highest
5	3	100	3	100	3	100	9	100.00	5.00	Highest
6	3	100	3	100	3	100	9	100.00	5.00	Highest
7	3	100	3	100	3	100	9	100.00	5.00	Highest
8	2	66.67	3	100	2	66.67	7	77.78	3.89	High
9	2	66.67	3	100	3	100	8	88.89	4.44	High
Mean	2.56	85.19	2.89	96.30	2.89	96.30	8.33	92.59	4.63	Highest
Std.Dev.	.50		.31		.31		.82			

According to Table 3, it was found that the mean score for the understanding about the nature of science in the three aspects was 92.59%. The scores in each aspect were the score of the scientific worldview was 85.19%, the score for scientific inquiry was 96.30%, and the score of the scientific enterprise was 96.30%.

According to the aforementioned statements, the education with the local science could develop the understanding about nature of science of the students in all mentioned aspects. Learning environments in the new era, online, on site, and real-life situation are integrated approach which help students learn to deal science in contexts. However, the misunderstandings of the nature of science in the aspects might be the learning activities that did not focus on integrating the nature of science with the scientific contents (Abd-El-Khalick & Lederman, 2000; Khishfe & Abd-El-Khalick, 2002). A guideline to develop the understanding about the nature of science was the learning activities with the local science by mixing the local wisdoms that consisted of the local stories and contents. Focusing on the students and their learning local science to meet requirements of understanding about nature of science (Phoopanna & Nuangchalerm, 2022). They can gain also appreciation, rationale, empathy, abilities to apply the scientific knowledge to their societies and lives, living skills that would be applicable and related to environments, societies, cultures and local factors (Jumriani et al., 2021).

This was consistent with the curriculum focusing on developing students into good and happy persons with educational and potential potentials. They should have the awareness of the conservation of local wisdom and cultures, environmental development as well as public minds (El Islami et al., 2018; Nuangchalerm & El Islami, 2018; Mesci et al., 2021; Nuangchalerm et al., 2022). This was also science must not be separated from lives and the ways of lives, but it should be the local education related to the mental processes and empathy of learners as well as natural and cultural facts. Science has locality and it is a process to obtain knowledge that are specific, theoretical, usually used for examinations or believed to be true as stated in texts without considering the steps while using visible tools.

However, there are many things that cannot be measured. This was the origin of the local science. The aim is to make Thai people know science as the process for developing knowledge by themselves. The science created by Thai people is not a western science or trend that used to be, but it is an opened-ended science that considers social relationships and spirits. The local science is the process for learning holistic knowledge from rational processes; records; systematical skills; environmental, social and cultural contents; and external factors affecting lives and environments as well as developing the understandings about locals leading to solving problems, self-reliance, sustainable developments and the ways of lives with natural balances (Sagala et al., 2019).

Therefore, it could be summarized that the education with the local science was the educational concept that could develop the understandings of the nature of science for the department of science and technologies. It allowed the students to learn their surroundings by having the communities and local cultures as the learning bases. It promoted the students to understand the nature of science, to learn the social and cultural processes and to appropriately apply the knowledge to their daily lives (Özyildirim, 2021).

Limitations of the study

Although this study descripts the understanding about nature of local science, it had some limitations. The school contexts in northeast of Thailand depends on school policy and administration. Local science knowledge requires community members' participation in transferring knowledge, understanding educational paradigm, and invitation science to informal education. In addition, an action research requires data from classroom observation, the period of time in COVID-19 outbreak may be made classroom activities in different.

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Ethics and Conflict of Interest

The authors acted in accordance with the ethical rules in the research. The authors declare that they have no conflict of interest.

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