Socioscientific-Issues Based Classroom Intervention on Grade 10 Students' Learning Achievement and Scientific Reasoning

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Abstract

Socioscientific-issues based instruction can promote science to students as a tool for necessary learning in the disruptive world. This instruction helps students critique and response as its nature of science, gaining higher-ordered thinking, and discussing with scientific reasoning. The objectives of this study were to compare learning achievement and scientific reasoning of grade 10 students. The topic "DNA technology" was employed with 90 grade 10 students from 2 classrooms. The quasi-experimental research was designed by comparing learning achievement and scientific reasoning between 2 learning organizations. The research tools were socioscientific-issues based and inquiry-based lesson plans, the achievement test consist of 30 items of 4 choices multiple test and scientific reasoning test. The statistic used to test the hypothesis was independent t-test. The results indicated that students had no difference score of learning achievement between learning organizations. While socioscientific-issues based learning had score of scientific reasoning higher than inquiry-based learning at the .05 level of statistically significance. The study can summarize that socioscientific-issues based learning can promote scientific reasoning to science classroom.

Keywords: Inquiry, Learning achievement, Scientific reasoning, Socioscientific-issues

1. Introduction

Science is the learning process and knowledge about natural world phenomena, which all human beings should learn for working and living in our societies. Today's world assumes that science plays an important role in economic, social, environmental, and educational development (Bulmer, 2021). Science is now can be called a society of the modern world which everyone needs to develop potential of science learning. Scientific knowledge is not only used to improve quality of life, but also helps to learn and live with uncertainty world (Prachagool & Nuangchalerm, 2021; Turhan & Demirci, 2021). Science enhances the human capacity to develop in connecting multi-dimensions studies. It also helps humans to have an accurate understanding of exploitation, so everyone needs to be developed to know science in order to have understandings of nature and the technology created by humans (El Halwany et al., 2021).

There are many forms of educational management to develop science that will encourage students to develop learning processes, especially learning management that focuses on learners. To develop students' scientific process skills, knowledge quests, and problem-solving skills, which are goals related to the learning management of the science learning areas (Duangrawa & Nuangchalerm, 2020; Juhji & Nuangchalerm, 2020). It focuses on enabling students to develop science process skills, thinking method, rational thinking, creative thinking, analytical thinking, critical thinking. These are important skills in researching knowledge that helps students the ability to solve problems in systematically. Decisions can be made using a wide range of information and verifiable testimonies (Emery et al., 2017).

Science is the common culture of the modern world, everyone must be developed knowledge and understandings into a science literacy. Scientific processes, including good attitudes towards science and technology, can use scientific knowledge in the daily life in a quality way. It can participate in scientific issues that arise in society and can be justified on the basis of science (Lawson, 2004). The management of science learning is intended to develop a complete humanity, logic, and is known to use the process of knowledge-seeking (Kinslow & Sadler, 2018; Ke et al., 2020; Zangori et al., 2020).

Learning management about science, society relevant to its movement as in current issues. It can improve students' learning achievement, critical thinking, nature of science, and scientific reasoning. The socioscientific-issues based instruction is subsequently driven to develop the potential of students to make decisions under scientific reasoning (Sadler, 2011; Zeidler et al., 2011; Kinskey & Zeidler, 2021). There is an ethical scientific dimension, bioethics, reasoning, and emotional development (Pharanat & Nuangchalerm, 2015; Ritsreeboon & Nuangchalerm, 2016; Svenaeus, 2017). Socioscientific-issues is a learning arrangement using the social issues that arise today and is yet to be inconclusive (Reis, 2014).

This is being debated in society due to differences in opinions about the accuracy, suitability of the concept. Scientific processes and technologies are practical problems, the problem is of interest to students. There are several solutions, endless answers for the natural phenomenon in appearances (Lin & Mintzes, 2010). It's a complicated problem that doesn't end. The issue

was debated under multiple views and lacked a clear answer to negotiations. The issues to be taken it into account must be based on morality and ethics, including science and non-science stories relevant to society movement (Evren-Yapicioglu, 2018; Foulk et al., 2020; Garrecht et al., 2020).

Society, economy and environment create an integration thought, social arguments within society. Thinking and doing with nature of science, it is as a tool to help students learn science, a meaningful learning that corresponds to the real life of learners (Hancock et al., 2020). The effective instruction in the modern classroom, students are socially responsible, are able to apply real-life scientific knowledge (Jafari & Meisert, 2019; Ke et al., 2020). The ability to reason scientifically is the ability to seek evidence or testimony, including ideas which students should be improved.

Students have ability to giving a reason scientifically that will be able to explain the phenomenon and make scientific decisions using scientific evidence or testimony. They obtained data by collecting information properly or through disputed discussions. Exchange of views leads to reasonable conclusions (Halim & Saat, 2017). Scientific principles or theories can be established by linking theory into practices. Those principles or theories, with their initial assumptions, and those who have the ability to reason scientifically (Ottander & Simon, 2021). This study has two hypotheses as follows:

(1) Students who study using socioscientific-issues based learning have higher learning achievement than inquiry-based learning.

(2) Students who study using socioscientific-issues based learning have higher scientific reasoning than inquiry-based learning.

2. Materials and Methods

2.1 Participants

Students who are attending grade 10 in the semester 2, academic year 2020. They are studying at Kalasin Pittayasan School, Secondary School Service Area 24, Thailand from 582 students, 14 classrooms. The samples are 90 of grade 10 students, obtained by cluster random sampling. Two classrooms divided into 45 students of socioscientific-issues based learning and 45 students of inquiry-based learning.

2.2 Variables

Independent variables are learning organization, including socioscientific-issues based learning and inquiry-based learning.

Dependent variables consisted of learning achievement and scientific reasoning.

2.3 Research Tools

Research tools include 8 learning plans of socioscientific-based learning and of inquiry-based learning topic "DNA technology", each learning plans consisted of 12 hours; a multiple choice with 30 achievement tests.; and scientific reasoning test with 8 situations.

2.4 Data Collection

The study employed pre-experimental research with two groups posttest design for data collection.

2.5 Data Analysis

The data were collected and analyzed based on testing 2 research questions:

(1) Students who study using socioscientific-issues based learning have higher learning achievement than inquiry-based learning? The data was test by independent t-test for comparing learning achievement between two groups.

(2) Students who study using socioscientific-issues based learning have higher scientific reasoning than inquiry-based learning? The data was test by independent t-test for comparing scientific reasoning between two groups.

3. Results

Mean scores of learning achievement between two groups were not shown statistical differences. But the mean scores of scientific reasoning between two groups were shown statistical differences at .05 level (Table 1).

Table 1. Comparing learning achievement and scientific reason between two groups

Variable	n	Socioscientific-issues based learning		Inquiry-based learning		t	p
		$\overline{X}$	S.D.	$\overline{X}$	S.D.		
Learning achievement	45	19.60	3.86	19.44	2.56	0.225	.822
Scientific reasoning	45	39.80	2.15	34.44	2.44	11.059	.000

Table 1, the mean sore of leaning achievement, socioscientific-issues based learning was 19.60, while inquiry-based learning showed mean score was 19.44. The independent t-test was not shown statistical differences between group. Scientific reasoning of students learning with socioscientific-issues based learning showed mean score was 39.80, the inquiry-based learning had mean score was 34.44. The statistical testing was shown statistical differences at .05 level.

4. Discussion

The study found that there were issues that should be discussed. The mean sore of leaning achievement, socioscientific-issues based learning and inquiry-based learning were not shown statistical differences between group. Scientific reasoning of students who learned by socioscientific-issues based learning and inquiry-based learning had significant differences at .05 level of statistics. The finding was not made surprisingly reported due to each lesson plans meet the learning standards and indicators which appeared in national curriculum.

However, scientific reasoning was the highlight of experimentation. Socioscientific-issues based learning can encourage students to express and discuss science by suitable reasoning. The use of open-ended questions stimulates analytical thought processes, as well as activities that allow all students to participate in finding answers and sharing ideas (Panasan & Nuangchalerm, 2010; Wongsri & Nuangchalerm, 2010; Siribunnam et al., 2014; Cahyarini et al., 2016; Siribunnam et al., 2019; Nida et al., 2021).

Socioscientific-issues based learning allowed students increase in scientific reasoning. Students might want to go their success of learning that requires understanding of the content of the lesson in order to have an understanding. It can improve student scientific reasoning, make decision based on evidences, explain of what they learn through scientifically discussed (Pitpiorntapin & Topcu, 2016; Nurtamara, 2019). In search of important issues, it is a step which teachers take the issues that are being disputed in society as issues related to science. It can be searched from social medium, search engine, or academic publications. Then apply issues to analyze the conformity of standards, organize learning activities and making the most appropriate choices with consideration as well. It is a widely discussed issue in society, appearing in various media articles appeared in journals or newspapers, TV shows or on social media, etc. (Shin et al., 2017; Bayram-Jacobs et al., 2019; Genisa & Subali, 2020).

5. Conclusion

Students had no difference score of learning achievement between learning organizations. While socioscientific-issues based learning had score of scientific reasoning higher than inquiry-based learning with statistically significance at the .05 level. It can be summarized that socioscientific-issues based learning can promote scientific reasoning to students as well.

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