

Meta-analysis: The Effectiveness of Using Socio-scientific Issues on Science Literacy and Students' Higher-Order Thinking Ability in Science Learning

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Abstract. *This study aims to determine the effectiveness of the use of socio-scientific issues on scientific literacy and higher order thinking skills of students in science learning. This research is a type of meta-analysis research. This research data comes from the analysis of 20 national or international journals that have been published from 2016-2022. The search for data sources comes from the Google Scholar, Eric Journal, ScienceDirect, and Springer databases. The sampling technique is purposive sampling technique. The data that is used as a sample must know the criteria that have a relationship with the research variables, namely social science on scientific literacy and students' higher order thinking skills in science learning. Data analysis is a quantitative data analysis technique with the help of JSAP.. The results of the study indicate that the use of socio-scientific issues affects students' higher order thinking skills by 47% and scientific literacy by 53% with an n-Gain of 0.50 medium category. This shows that the use of socio-scientific issues in science learning has a significant effect on students' higher-order thinking skills and scientific literacy.*

Keywords: *Socio-scientific Issues, Higher Order Thinking Skills, Scientific Literacy, Science Learning.*

Introduction

21st century education not only pays attention to core subjects as happened in the previous century, but also places emphasis on life skills, learning and thinking skills, literacy in information and communication technology (Zulyusri et al., 2022). (ICT Literacy)(Pauzi & Windiaryani, 2021; Nia, et al, 2021). In line with 21st century skills, scientific literacy is quite a major concern of the scientific literacy community, it is urgently needed to answer and deal with global issues in the 21st century(SN Pratiwi, 2019; Zeidler et al., 2009; Oktarina et al., 2021). Students as part of society need to be formed to become a literate society in science through scientific literacy learning(Nazilah et al., 2019; Rahmasiwi et al., 2018). Students who have scientific literacy will have the ability to care about and respond to issues that develop in society, think critically and creatively, and have in-depth knowledge and understanding to apply (Suparman et al 2022; Mudawamah, 2020).

Based on PISA 2018 that the value or score of the scientific literacy level of students in Indonesia is 396, this shows that it is well below the OECD average and has decreased significantly, from 403 to 396 (Schleicher, 2019; Razak et al., 2021). This shows that Indonesian students still have difficulty connecting science and scientific facts in everyday life(OECD, 2019). Although the PISA study was conducted on junior high school students, the weakness of these results must be accepted attention in learning at the secondary school level. Learning in secondary schools needs to ensure that scientific literacy the weaknesses of junior high school students can be overcome in learning in high school(Andari & Setiawan, 2014). This scientific literacy needs to get serious attention and be addressed immediately to improve the quality of Indonesian education(Shinta et al., 2020; Rahayu et al., 2022)

Learning needs to be supported by the availability of teaching materials in accordance with the criteria of 21st century teaching materials, which include dimensions of scientific literacy such as content, procedures, and scientific behavior in real life environments(Naezak et al., 2021). Scientific literacy has many facets, which include understanding scientific experiences with High Order Thinking Skills (HOTS) to solve challenges that exist in the real environment(Purnami et al., 2021; Fahrissa, 2022). Current teaching materials only emphasize content, without any process and behavior, so it is predicted to be the cause of students' below average scientific literacy levels (Fradila et al., 2021). Therefore, there is a need for alternative Socioscientific Issue (SSI)-based teaching materials that can improve students' scientific literacy and thinking skills(Rostikawati & Permanasari, 2016)

Science learning is something that must be done by students, not something that done to students. Science learning that based on content standards will shape students who have the provision of knowledge, standards the process of forming students who have scientific skills, thinking skills and thinking strategies, scientific inquiry standards will form students who are able to think critically and creative (Rohmawati et al., 2018). Related approaches with scientific and social issues is called the socioscientific approach. Socioscientific approach considered to be able to provide a way of learning to explore aspects of science (Science Natural Knowledge) learners through developing issues, where this approach can be delivered using class discussions, and case-based problem learning (Santosa et al., 2021).

The socioscientific approach is a learning approach that investigates and study the existing facts, phenomena that occur, or events that are happening based on issues and problems related to science in life Public (Sismawarni et al., 2020). The socioscientific issues approach presents a learning using problems that are related to science material (Hestiana & Rosana, 2020). Issue or the problem raised is a social issue that is developing in the community (Masfuah & Pratiwi, 2013). Socioscientific issues require complex thinking with scientific concepts on issues broadly and openly in the process of exploring them. By Therefore, this socioscientific approach can improve scientific thinking skills through complex, critical and analytical thinking (Çalik, M., & Coll, 2012). Based on this, this study aims to look at the Meta-Analysis: the effectiveness of the use of socio-scientific issues on scientific literacy and students' higher order thinking skills in science learning.

Materials and methods

The research used by the researcher is a type of meta-analysis research. Meta-analysis is a type of research that is carried out by summarizing, reviewing and analyzing research data from various research results that have existed before. The research population came from a search of 20 national and international articles published in 2016-2022. Researchers collect data by browsing articles related to socioscientific issues contained in online journals using Google Scholar and Sage Journals.

The keywords used by the researcher in searching the articles were “socioscientific issues”, “higher order thinking” and “scientific literacy”. The search results using these keywords will select articles that match the needs of the researcher. The sampling technique is proportional sampling technique. Technical data analysis is quantitative and qualitative analysis by measuring and looking at n-Gain. Calculation of n-Gain is done using the formula contained in Hake (2002):

Table 1. Criteria for n-Gain Score

n-Gain Score	Criteria
n-Gain > 0.7	Tall
0.3 < n-Gain 0.7	Currently
n-Gain 0.3	Low

Source: Hake, 2002; Andriani, 2017; Santosa et al., 2021.

Results and Discussion

This study has reviewed 20 national and international journal articles that examine the research on the effectiveness of using socioscientific issues on scientific literacy and students' higher order thinking skills in science learning. From these results are presented in the following table:

Table 2. Meta-analysis seen from the type of research

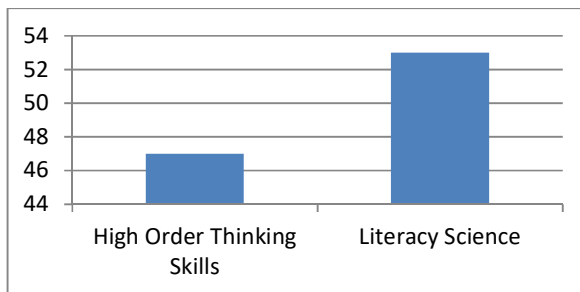
No	Types of research	Frequency	Relative Frequency %
1	Descriptive	3	16.5
2	Experiment	12	60.5
3	CAR	1	33.3
4	R&D	4	55.4
	Amount	20	

Table 3. Meta-analysis seen by Author and n-Gain

No	Author	Year	n-Gain	Category
1	Indang, et al.	2022	0.66	Currently
2	Sulistiani, et al.	2022	0.26	Low
3	Pauli & Windiaryani	2021	0.38	Currently
4	Alfitriyani, et al.	2021	0.59	Currently
5	Khusnul Mudawamah	2020	0.33	Currently
6	Hestiana & Dadan Rosana	2020	0.49	Currently
7	Kusumaningtyas, et al.	2020	0.31	Currently
8	Sismawarni, et al.	2020	0.71	Tall
9	Adinda Rahmayani	2019	0.40	Currently
10	Nazilah, et al.	2019	0.33	Currently
11	Pandela, et al.	2019	0.77	Tall
12	Intan, et al.	2019	0.68	Currently
13	Putriana, et al.	2018	0.50	Currently
14	Nova & Zuhdan Kun	2018	0.61	Currently
15	Prasetyo	2018	0.71	Tall
16	Rohmawati, et al.	2018	0.36	Currently
17	Jariska, et al.	2018	0.56	Currently
18	Rahmawati, et al.	2018	0.37	Currently
19	Amining, et al.	2017	0.60	Currently

20	Kartika, et al. Rostikawati & Anna	2016	0.44	Currently
Mean			0.50	Currently

Table 4. Meta-analysis of Socio-scientific Issues on Higher Order Thinking and Scientific Literacy



Discussions

Based on table 2 the meta-analysis was carried out on 20 national and international journal articles consisting of 3 types of descriptive research with a relative frequency of 16.5%, 12 types of experimental research with a relative frequency of 60.5%, 1 type of CAR research with a relative frequency by 33.3% and 4 types of research Development and Research (R&D) with a relative frequency of 55.4%. Table 3 explains that 20 articles that have been explored related to the effect of using socio-scientific issues on scientific literacy and students' higher order thinking skills in science learning where the mean n-Gain value of 0.50 is in the medium category. It can be concluded that there is an effect of using a socioscientific issue approach on scientific literacy skills and students' critical thinking skills in science learning (Suhaimi et al., 2022; Amalia et al., 2022).

PISA is one of the international studies that measures the cognitive abilities of student participants with the questions tested are questions that require higher-order thinking skills (OECD, 2019). There are three aspects assessed in this PISA, one of which is scientific literacy. Based on PISA 2018 announced that the value or score of the scientific literacy level of students in Indonesia is 396, this shows that it is well below the OECD average and has decreased significantly, from 403 to 396 (Schleicher, 2019). Scientific literacy is the ability of students to recognize concepts, understand, explain, communicate science, apply science in everyday life to solve daily problems and relate to the material that has been studied (Khalid, L., Bucheerei, J., Issah, 2021). Scientific literacy fosters a positive attitude and good sensitivity towards self and the environment or interactions (Sumarni, 2018). One of the things that makes students' scientific literacy low in Indonesia is that teaching materials are not based on Socio-Scientific Issues (SSI) (Sya'ban, MF, & Wilujeng, 2016).

Issues related to everyday life will be more easily understood by students so as to improve students' thinking skills (Purnami et al., 2021; Rohmawati et al., 2018). This is also in accordance with research from (Nugraha et al., 2017) that by presenting socio-scientific issues can improve students' critical thinking skills, especially on indicators providing simple explanations because students can solve problems given based on information that has been obtained or is known.

Table 4 illustrates that there is a use of social scientific issues that has an influence on scientific literacy and higher order thinking skills of students in science learning with 47% and 53% respectively. The scientific literacy ability of students is closely related to higher order thinking skills (Razak et al., 2021; Santosa et al., 2021). Higher order thinking ability is a thinking ability that not only requires the ability to remember course, but requires other higher abilities, such as analytical, synthesis, and evaluation skills (Gavrinskaya et al., 2022; Indah et al., 2021). Based on the results of research conducted by (Yuriza et al., 2018) could be concluded that there is a positive relationship between higher order thinking skills and scientific literacy skills in junior high school

students. This means that the increase in higher-order thinking skills and intelligence levels is followed by better scientific literacy skills for junior high school students.

Conclusions

From the research above, it can be concluded that the use of socio-scientific issues affects students' higher order thinking skills by 47% and scientific literacy by 53% with an n-Gain of 0.50 medium category. This shows that the use of socio-scientific issues in science learning has a significant effect on students' higher-order thinking skills and scientific literacy.

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