



From Application of Socio-Scientific Issues in Chemistry Learning to Improve Science Literacy and Awareness Student Social

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Abstract

The Socio-Scientific Issues (SSI) approach is a learning strategy based on social issues related to science, which aims to improve students' scientific literacy and critical thinking skills. And this approach is able to improve students' scientific literacy and social awareness by connecting chemical concepts to real-world social challenges. This literature review examines the effectiveness of SSI-based learning in improving critical thinking, argumentation skills, and contextual understanding among students. The research method used is a literature review using 10 journals as findings showing that SSI encourages deeper engagement by connecting chemistry to issues such as environmental pollution, industrial waste, and sustainable development, making learning more relevant and meaningful. However, challenges such as limited teacher familiarity with SSI integration, curriculum constraints, and students' difficulties in analyzing complex socio-scientific debates hinder its widespread implementation. Proposed solutions include teacher training programs, adoption of problem-based and inquiry-based learning models, and institutional support for curriculum development. The study concludes that SSI significantly improves scientific literacy and decision-making skills when supported by structured pedagogical strategies and institutional commitment. Future research should focus on a scalable SSI implementation framework and its long-term impact on students' social and scientific competencies.



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1. Introduction

Chemistry education is not only based on the goal of improving the understanding of scientific concepts, but also to form scientific literacy associated with social awareness of students. Good science literacy allows students to understand, evaluate, and apply chemical concepts in everyday life, and make

decisions based on scientific understanding. However, in reality there are still many students who experience obstacles in connecting chemical concepts with real problems that arise in society.

The Socio-Scientific Issues (SSI) approach is a learning strategy based on social issues related to science, which aims to improve students' science literacy and critical thinking skills (Arthamena et al., 2024). Currently, the level of chemical literacy of high school students is still relatively low, so a process of reconstructing the structure of chemistry learning content associated with real-life contexts is needed (Sulistina & Hasanah, 2024). This approach emphasizes student involvement in discussions and problem solving relevant to everyday life (Çalık & Wiyarsi, 2021). Social Scientific Themes (SSI) can be used as a learning context to improve scientific competence. Social Science Problem (SSI) Context Guardians or social problems are conceptual and procedurally open questions, with potential rational solutions that can affect social aspects such as cultural identity, economic politics, and ethics (Azizah et al., 2021). In chemistry learning, SSI has been used to improve students' understanding of abstract concepts by connecting them with real phenomena (Fitri & Wiyarsi, 2024). For example, environmental issues such as air pollution and industrial waste can be used as a context for understanding redox reactions (Afrilya et al., 2022). The advantages contained in the SSI approach can bridge students' needs for teaching materials that link learning to life. As revealed by Suharyadi et al. that instructional teaching materials found in schools have not linked learning materials with the social lives of students (Sofiana & Wibowo, 2019).

Socio-Scientific Issues applied in science learning is expected to provide a more meaningful learning experience (Fikrawati et al., 2024). Various studies have shown that this approach can improve students' scientific argumentation skills because they have to analyze various perspectives before making decisions (Habibah & 'Ulya, 2024). In addition, this approach can also increase students' learning motivation by making the material more relevant and meaningful (Jayanti & Dina, 2024).

The Socio-Scientific Issues (SSI) approach has been widely developed and applied as one of the learning strategies that link social issues of life with science concepts. SSI in chemistry learning can involve various important issues, such as climate change, environmental pollution, the use of chemicals in industry, and waste management. Through this SSI approach, students are invited to think critically, evaluate the social impact of chemistry on the environment, and hone argumentation skills based on scientific evidence.

There are still many lecturers who use conventional methods that do not encourage student involvement to conduct in-depth discussions and do not encourage to think about real-life issues. This causes a low level of social awareness by students in applying chemistry solve problems in society.

Therefore, it is important to conduct further research and development regarding the application of the SSI approach in chemistry learning. It is hoped that this paper can provide insight into the effectiveness of using the SSI approach in improving science literacy and social awareness 111 among students. as well as providing recommendations for the learning process curriculum development that is more contextual and relevant to the needs of the times.

2. Materials and Methods

This study was conducted using the Literature Review method by searching for related and comprehensive topics. Articles or journals taken based on research that has been trusted and searches are conducted via the internet. The keywords used are "Socio Scientific Issues in Chemistry Learning". The journals used in this Literature Review were obtained by searching on SciSpace, Google Scholar and other sites. In this study, 10 journals were used to be reviewed and then the data collected will be analyzed, then structured and compared between research articles or relevant literature.

3. Results and Discussions

Table 1: Literature Review on the Application of Socio-Scientific Issues in Chemistry Learning to Improve Science Literacy and Social Awareness of Students

Researcher	Research Title	Intervention	Results	Research Conclusion
Muammer Çalık, Antuni Wiyarsi	A Systematic Review Of The Research Papers On Chemistry-Focused Socioscientific Issues.	Use of an approach that linking social issues with chemistry concepts to improve understanding And student engagement. With the development of lesson plans that focus on issues such as the use of conventional and green pesticides.	The use of Socio-Scientific Issues (SSI) in chemistry learning can increases student engagement and helps them develop critical thinking skills and decision-making skills in the context of social context and chemistry.	Integration Socio-Scientific Issues (SSI) in chemistry learning can increase the relevance of chemistry education with real life, as well as improving students' critical thinking skills and scientific literacy.

<p>Dinda Nur Azizah, Dedi Irwandi, and Nanda Saridewi</p>	<p>Influence <i>Problem Based Learning Model Learning Context Socio Scientific Issues</i> on Students' Science Literacy in Acid-Base Matter</p>	<p>Contextualized learning SSI involves social science issues that are open-ended and can be influenced by social aspects such as identity culture, political economy, and ethics.</p>	<p>Students who take part in learning with the context of SSI are more involved in the learning process and are able to understand the relationship of the concepts they learn to everyday life situations. Besides In addition, use of SSI context makes learning more interactive and helps students practice argumentation skills and make decisions on issues in society.</p>	<p>Students who engaged in this learning demonstrated a better understanding of the relationship. Between concepts learned and real-life situations. In addition to In addition, learning with context SSI make process learn more interactive and helping students in developing argumentation skills and retrieval decisions on social issues.</p>
<p>Asti Aulia Jayanti and Dina</p>	<p>Development Video Based Socio Scientific Issues As Media Sustainable Development Learning Hydrocarbons and Petroleum Materials</p>	<p>Integrating environmental issues environment to in learning process chemis Try such as hydrocarbons and petroleum.</p>	<p>Video based learning Socio- Scientific Issues (SSI) that developed to support sustainable development education on the material hydrocarbons and oil is considered very feasible to use. This video consists of three controversial issues that are relevant to the curriculum and can be accessed online.</p>	<p>Students become more active in give opinions and get involved indiscussion of relevant controversial topics with life everyday life. This shows that the SSI approach can improve students' understanding of chemistry concepts and their awareness of issues environment and Social.</p>
<p>Vegha Dwi Arhamena, Mizzan Ayubi, Sri Atun, Suyanta</p>	<p>Use of Socio-Scientific Issues in Chemistry Learning</p>	<p>Development of argumentation skills, increased environmental awareness, and Increased student motivation.</p>	<p>Use of Socio-Scientific Issues (SSI) can have a positive impact on argumentation skills and decision-making skills students' argumentation and decision-making skills related to the issues they face. In addition, SSI can also be used to improve critical thinking skills and environmental awareness. However, the application of SSI is still rarely used by teachers for various reasons, including lack of understanding and expertise in integrating SSI into in learning.</p>	<p>Usage Socio- Scientific Issues (SSI) in Education Science, especiall in chemistry learning, proven effective in improvingscience literacy, critical thinking skills, and argumentation ability students by linking learning with real- world contexts. Nonetheless, the application of SSI in the classroom is still limited due to lack of understanding and resources among teachers.</p>

<p>Radjawali Usman Rery1, Tri Padila Rahmasari.</p>	<p>Research Trend of Socio- Scientific Issues on Chemical Kinetic Materials: Literature Review.</p>	<p>The application of socio-scientific issues (SSI) in this journal involves a variety of strategies to improve science literacy, critical thinking skills, and environmental awareness.</p>	<p>Application Socio-Scientific Issues (SSI) in learning shows some findings Important that impact positiv eimpact on development students' academic and social skills. One of one The main finding is an increase in science literacy, where students become better able to understand and apply scientific concepts. and apply scientific concepts in a real context.</p>	<p>The application of socio-scientific issues (SSI) in learning has a positive impact on various aspects of education. SSI can improving science literacy of students with help them understand And apply scientific concepts in a real context This approach also improves critical thinking skills and students' scientific argumentation, which is important for analysis and information evaluation.</p>
<p>Hajidah Salsabila Allissa Fitri</p>	<p>Efficacy Self Calon Teachers To Design Chemistry Learningbased On Context Socio-Scientific Issues</p>	<p>Research This research did not explicitly explicitly mention the intervention that conducted. However, the main focus is on analyzing the self-efficacy of prospective chemistry teachers in designing socio-scientific issues (SSI)- based learning. designing learning based on the context of socio-scientific issues (SSI). This research survey method to collect data from 262 prospective teachers at Yogyakarta State University.</p>	<p>The results showed that:</p> <ul style="list-style-type: none"> - 85% of chemistry teacher candidates have very high self- efficacy. - 6% have high self- efficacy. - 8% had moderate self- efficacy. - 1% have low self- efficacy. <p>In addition, the self-efficacy of prospective Teacher influenced by knowledge and experience. There is a significant difference between semester students earlyand late semester students, with 5th semester students reporting higher self- efficacy than students in semester 7. The decrease in self- efficacy in semester 7 may be due to the practical teaching experience that showed real challenges in the classroom.</p>	<p>That majority of prospective teachers chemistry teacher candidates have very high self-efficacy in designing context- based learning. This shows the potential that for professional development in this area. The research also emphasizes the importance of developing self- efficacy self-efficacy to improve the quality of learning chemistry learning in schools. The authors would like to thank to the University of State University of Yogyakarta for support in the implementation of this research.</p>

Nur'Aida Afrilya, Neti Afrianis, and Nurhadi	The Effect of Applying the Socio Scientific Issues on Literacy Science Students on Petroleum Material	Research This research uses the learning approach Socio Scientific Issues (SSI) at material petroleum subject matter in high school Negeri 5 Pekanbaru. Approach. This approach was applied to the experimental class, while the control class used the which is recommended in K-13, namely Scientific. Both classes were given a pretest before treatment and a posttest after treatment. after treatment to measure students' science literacy skills.	After the application of the SSI approach, there is an increase in the average posttest score in both classes, bothboth experimental and control. However, The increase in science literacy was more significant in the experimental class compared to the control class. The average percentage of students' science literacy posttest in the experimental class was 81.801%, while in the control class it was 77.495%. In addition to That the increase in science literacy in the experimental class is classified in category 'high' with an N-Gain score of 0.7352.	Implementation of the learning approach Socio Scientific Issues (SSI) has influence positiv e influence on ability students' science literacy on petroleum materials. This is shown with better posttest results the experimental class compared to the control class, as well as a significant increase in science literacy. significant increase in science literacy. This approach also increases students' curiosity and analytical thinking skills in solving problems.
Wa Ode Fikrawati, Muhammad Alim Marhadi, Esnawi	Analysis of Students' Science Literacy Using the Socio-Scientific Issues (SSI) on Solution Materials Buffer for Students of Class XI IPA SMA	Research This research uses the Socio- Scientific Issues (SSI) approach in the learning material solution in class XI MIPA 1 SMAN 12 Kendari. This approach involves experimental activities and Reflection method to train students' science literacy skills.	Results analysis data analysis results show that the ability of science literacy students with the SSI approach on the material buffer solutionhas an overall average of 74.49 science literacy indicators, which is categorized as good. In addition, students showed good ability in explaining the implications of knowledge scientific for society, with Achievements highest achievement was 75.80.	The Socio- Scientific Issues (SSI) approach can train students' science literacy well on buffer solution material. Students are able to draw conclusions from the experiments conducted and master the concepts taught.
Febbi Ayu Nur Habibah , Asma Amaniatal Ulya	Efforts To Develop Students' Science Literacy Skills Through Problem-Based Learning (Pbl) Based On The Socio-Scientific Issue (Ssi) Approach	The intervention carried out in this study is the application of the Problem Based Learning (PBL) learning model with the Socio-Scientific Issue (SSI) approach to improve students' science literacy skills. In the learning process, students are invited to discuss social science issues such as the impact	The results of the study showed that learning with PBL model based on SSI is effective to improve students' science literacy skills. This is supported by the posttest results which show that the experimental class that applies the SSI method has higher science literacy skills than the control class.	The conclusion of this research is that efforts to develop students' science literacy skills can be done with Problem Based Learning based on Socio-scientific Issue Approach. This approach helps learners make sense of natural phenomena from a scientific perspective and improves their science

		of global warming and its prevention. They use the Padlet app to exchange opinions and find solutions to problems. discussed.		literacy skills.
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Discussions

According to research by Çalık and Antuni, 2021 regarding the application of Socio-Scientific Issues (SSI) in chemistry education supports the relevance model by linking chemistry concepts with real social issues, thus increasing student engagement and understanding, by linking learning with socio-scientific issues, students can develop better decision-making skills in social and scientific contexts. In addition to improving scientific literacy, the application of Socio-Scientific Issues (SSI) in chemistry education also helps students develop critical thinking skills and the ability to argue scientifically. By exposing students to complex real issues, they are encouraged to analyze information, consider multiple points of view, and make informed decisions. SSI is based on scientific evidence and increases students' learning motivation by making learning more relevant and contextualized but to achieve optimal results, support is needed in the form of teacher training and curriculum development that enables effective integration of SSI.

And according to Azizah et al, 2021, it is more or less the same as Çalık and Antuni's research, 2021, where SSI significantly improves students' science literacy skills, especially in acid-base materials. Students who engage in this learning show a better understanding of the relationship between the concepts learned and real-life situations and make the learning process more interactive and help students develop argumentation and decision-making skills related to social issues. However, the challenges faced are in designing learning materials relevant to the SSI context, the need for teacher training to manage complex discussions, as well as possible resistance from students who are not used to a more interactive and problem-based learning approach.

And another way of applying socio-scientific issues in chemistry learning was found by Jayanti and Dina' research, 2024 is by using socio-scientific issues (SSI) based learning videos as a medium for learning sustainable development which has an impact on students becoming more active in giving opinions and engaging in discussions on controversial topics relevant to everyday life. This shows that the SSI approach can improve students' understanding of chemistry concepts and their awareness of environmental and social issues. The barriers are similar to the previous two researchers in that teachers may face challenges in integrating controversial issues into the existing curriculum and students may have difficulty in understanding and discussing complex issues that require critical thinking and good argumentation skills. Based on the review of several journals above, based on the results of the research, it was found that Socio-Scientific Issues in chemistry learning supports the relevance model by linking chemical concepts with real social issues, thereby

increasing student engagement and understanding, by linking learning with socio-scientific issues, students can develop better decision-making skills in social and scientific contexts. In addition to improving scientific literacy, the application of Socio-Scientific Issues (SSI) in chemistry education also helps students develop critical thinking skills and the ability to argue scientifically. Socio-Scientific Issues has a very positive impact on students in showing a better understanding of the relationship between the concepts learned and real-life situations as well as making the learning process more interactive and helping students in developing argumentation and decision-making skills related to social issues. However, there are barriers and difficulties in implementing Socio-Scientific Issues (SSI), namely that teachers may face challenges in integrating controversial issues into the existing curriculum and students may have difficulties in understanding and discussing complex issues that require critical thinking and good argumentation skills.

In response to various challenges, we propose solutions in the form of several feasible strategies. Initially, it is imperative to implement training programs for educators to increase their confidence in Socioscientific Problem Instruction (SSI), which could include workshops, educational modules, and communities for experience exchange. In addition, the utilization of SSI-based pedagogical models, such as Problem-Based Learning (PBL), Inquiry-Based Learning (IBL), and interactive discussions, can facilitate the development of critical thinking and argumentative skills among students. In practical scenarios, students can be presented with authentic cases, such as the consequences of environmental pollution resulting from industrial chemical waste, and then tasked to analyze and propose evidence-based solutions. In addition, the integration of SSI in the chemistry curriculum should be strengthened by including the subject subjects such as environmental chemistry, ethics in chemical science, as well as the social implications of chemical applications in industry and health. In addition, institutional support for educators and students is essential to ensure effective implementation of SSI in chemistry education. Higher education institutions can offer structured SSI-based learning modules, in addition to creating opportunities for educators to design more contextually relevant teaching methodologies. Furthermore, evaluative measures for learning should be aligned with the SSI framework, for example, through project-based assignments, reflective essays, or scientific presentations, which prioritize students' understanding and analytical abilities over mere memorization of concepts.

5. Conclusions

The application of Socio-Scientific Issues (SSI) in chemistry learning has been proven effective in increasing student engagement and understanding by linking chemistry concepts to real social issues. This approach also plays an important role in helping students develop critical thinking skills, scientific argumentation, and evidence-based decision-making ability. However, the implementation of SSI is not without challenges, such as difficulties in integrating controversial issues into the curriculum, limitations in teacher training, as well as barriers experienced by students when understanding and discussing complex topics.

To overcome these obstacles, strategies are needed that include training for teachers, applying problem-based learning models (PBL, IBL), and interactive discussions. In addition, integration of SSI materials into the chemistry curriculum can be done through environmental chemistry and scientific ethics approaches. Support from educational institutions as well as project-based evaluation methods and scientific analysis are also very important to ensure the effectiveness of SSI in improving science literacy and the relevance of chemistry learning among students.

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