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# Implications of the Socio-Scientific Issues Approach on Students' Creative Thinking Skills in Science Learning: A Systematic Literature Review

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**Abstract:** Science learning through the Socio-Scientific Issues (SSI) approach aims to help students understand scientific concepts and develop creative thinking skills through engagement with socially relevant contexts. However, despite its potential, students often struggle to generate and express creative ideas when dealing with scientific problems, suggesting that the creative dimension of SSI based learning is not yet fully realized in practice. Previous studies have demonstrated SSI's effectiveness in enhancing scientific literacy, critical thinking, and argumentation, yet research on its role in fostering creative thinking remains limited. This study conducts a systematic literature review (SLR) to analyze how SSI based learning influences students' creative thinking skills. The review includes international and national articles indexed in Scopus, Sinta 1–4, and open-access international proceedings published between 2021 and 2025. Selected studies discuss the implementation of SSI in school-level science learning using quantitative, qualitative, R&D, or mixed-methods designs. From 17 reviewed articles, quantitative approaches were found to be predominant. The findings indicate that SSI-based science learning can promote students' flexible, early, and open-minded thinking in addressing scientific issues, thereby supporting the development of creative ideas.

**Keywords:** Creative thinking skills; Science learning; Socio-scientific issues

## Introduction

Education plays a crucial role in enhancing intelligence and the quality of human resources in line with advancements in science and technology, societal development, and development demands. In the 21st century, technological progress and globalization have brought about rapid changes across various aspects of life.

In today's modern world, everything can be easily digitized and automated. 21st century skills are important skills that everyone must master in order to succeed in the challenges, problems, life, and career in the 21st century (Aliftika et al., 2019; Redhana, 2019). One of the skills needed to face the challenges of the 21st century is creative thinking, where individuals learn to express ideas and develop solutions to problems, see existing possibilities, and transform them into new products or ways of life (Lucas, 2022). The same thing was also stated by Trianggono (2017), creative thinking is a person's ability to think from different perspectives and use their imagination to generate new ideas that can be used to solve problems.

Science education plays a vital role in the 21st century in preparing students to face the complex challenges and opportunities of the modern world (Yunita & Mandasari, 2025). Science education requires individuals to think creatively. This is because science involves exploration, observation, and problem-solving processes that often require new ideas and innovative

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solutions. In other words, creativity is an integral part of how science is conducted (Cahyaningsih et al., 2023).

The reality of science education in the field is indeed fraught with obstacles. Students often struggle to solve problems, especially those related to scientific concepts (Artawan et al., 2022). This is reflected in the results of the Program for International Student Assessment (PISA), a program run by the Organization for Economic Co-operation and Development (OECD) that aims to measure the skills of 15-year-old children from various countries around the world in the fields of reading literacy, mathematics, and science. Based on the 2022 PISA results, only 25.46% of Indonesian students achieved at least level 2 in reading proficiency, a figure far lower than the OECD average of 73.75%. The percentage of Indonesian students who achieved level 2 was even lower for mathematics proficiency, at only 18.35%, making it the lowest among the three assessment areas. This achievement is over 50% below the OECD average of 68.91%. In science, 34.16% of Indonesian students achieved level 2, which is still far below the OECD average of 75.51% (OECD, 2023).

Low creative thinking skills in science learning can be caused by several factors, including low literacy, poor mastery of science concepts, poorly organized learning, lack of opportunities to conduct experiments or discover concepts independently, and lack of stimulation for higher-order thinking (Primadoni & Muslim, 2023). Holbrook & Rannikmae (2009) state that low literacy has a negative impact on the development of creativity and the utilization of scientific knowledge in daily life to solve problems, make decisions, and improve quality of life. Another factor contributing to low creative thinking skills in science education can be linked to a lack of understanding of global contexts and social dynamics. Students' disconnection from global issues and social changes hinders their ability to transfer scientific knowledge into contextual situations and develop innovative solutions to real-world problems (Zanden et al., 2020). A learning focus that prioritizes cognitive aspects, such as mastering concepts, without providing opportunities for experimentation or creating new solutions, can hinder the development of creative thinking skills (Qomariyah & Subekti, 2021).

In order to improve the learning process in the classroom, one approach is to use contextual problems, also known as Socio-Scientific Issues (SSI) based learning. SSI are defined as social problems related to science that are complex, controversial, and spark debate. SSI do not have definitive answers or fixed solutions but are open-ended (Sadler & Zeidler, 2004). SSI involve using science topics to encourage students to engage in dialogue, discussion, and debate. These issues are generally controversial but also require moral reasoning or the evaluation of ethical aspects in the decision-making process regarding the possible solutions offered. This approach aims to make the issues discussed personally meaningful and engaging to students. In addition, students are encouraged to use evidence-based reasoning and develop scientific understanding through contexts relevant to real life (Zeidler & Nichols, 2009).

Literature research over the past five years has proven that SSI based learning is an effective method in science education, while also equipping students with the basic skills to face global challenges in the modern era (Falah et al., 2024; Sari et al., 2025). One of the most widely studied trends is the positive impact of SSI on students' science literacy, as this approach allows students to connect scientific knowledge with real-life contexts (Husniyyah et al., 2023; Nurhadi, 2022; Saija et al., 2022). On the other hand, SSI has been proven to help improve critical thinking skills significantly. It is because SSI forces individuals to consider an issue's scientific, social, and ethical aspects, which requires deeper thinking and careful analysis (Kolstø et al., 2024; Pratiwi et al., 2016). The critical thinking skills developed in students encourage them to construct strong scientific arguments, base their opinions on scientific evidence, and consider various perspectives or alternative arguments objectively (Dawson & Venville, 2022; Zhang et al., 2023).

Based on the literature review, the SSI approach has many advantages when applied in learning, especially science learning. The current research trend related to SSI continues to develop, with most previous studies on SSI based learning focusing on developing science literacy, critical thinking skills, and scientific argumentation. However, very few studies have thoroughly examined the impact of SSI learning on students' creative thinking skills. However, creative thinking ability is one of the key elements of 21st century skills needed to address global challenges innovatively and adaptively (Haryanti & Saputra, 2019). On the other hand, to date, there has been little discussion specifically addressing which learning models can be combined with the SSI approach, the types of instruments used to measure students' critical thinking skills after learning with the SSI approach, the science learning materials that can be taught through this approach, and the impact of its implementation on students' critical thinking skills. Therefore, a systematic literature review is needed to analyze the application of the SSI approach in science education in greater depth.

## Method

This study used a systematic literature review (SLR) method to determine the application of the SSI approach to students' creative thinking skills in science learning.

The systematic literature review method is a research methodology used to collect, identify, and critically analyze available research studies, such as scientific articles and conference proceedings, through a systematic procedure (Carrera-Rivera et al., 2022). SLR aims to provide readers with updates on the latest literature related to a topic by examining key points from current knowledge relevant to the research question, while also recommending areas that still need to be explored further (Kitchenham et al., 2009). According to Mengist et al. (2020), literature review studies are conducted through several stages known as PSALSAR (Protocol, Search, Appraisal, Synthesis, Analysis, and Report). The PSALSAR procedure can help researchers reduce bias, increase transparency, and produce a more systematic literature review. The research process is further detailed in Table 1.

**Table 1.** Research flow systematic literature review

| Steps | Outcomes | Methods |
|---|---|---|
| Protocol | The research protocol, including the research questions | Define the scope of the research transparent and replicable |
| Search | The search strategy helps to define an appropriate search string and identify the relevant databases to collect the relevant documentation | Searching strings |
| Appraisal | Extract and categorize the data | Selecting good quality literature |
| Synthesis | Data extraction and categorization of the data | Sort the data into categories according to the iterative definition and get it ready for additional examination. |
| Analysis | Data analysis; Result and discussion; Conclusion | The arranged data's quantitative classifications, description, and narrative analysis; Based on the analysis, show the patterns, find the gaps, and compare the results; Get to conclusions and give suggestions |
| Report | Articles published in scientific journals. | Communicating results transparently |

At the protocol stage, researchers need to determine research questions to explore further the implications of the SSI approach on students' creative thinking skills. The research questions to be addressed in this study are: What research designs (methods) are predominantly used in studies implementing the SSI approach to develop creative thinking skills?; What are the outcomes of students' creative thinking skills after using the SSI approach?; and What learning instruments are used in implementing the SSI approach to support the development of students' creative thinking skills?

The next step involves conducting a literature search, starting with searching for articles in the Publish or Perish 8 application, sourced from the Google Scholar database, using keywords such as "Socio Scientific Issue," "SocioScientific Issue," "Socio-Scientific Issue," "SSI," "creative thinking," and "creative thinking skills." The data collected consisted of journal articles published from 2021 to 2025. This was followed by a selection process based on inclusion and exclusion criteria. This literature review study determined the eligibility criteria based on inclusion and exclusion criteria. The inclusion criteria were: Literature in the form of international and national scientific journals indexed in Scopus, Sinta 1, Sinta 2, Sinta 3, and Sinta 4, and/or international proceedings discussing the application of SSI learning at the elementary, junior high, and high school levels; Scientific journals and/or proceedings with open access; Articles must be accessible in full text; Scientific journals and/or proceedings use English or Indonesian; The publication year of scientific journals and/or proceedings is between 2021-2025; and The research design can be quantitative, qualitative, developmental, and mixed methods. The exclusion criteria in this study are journal articles that do not meet the inclusion criteria. This process resulted in articles discussing the implications of applying SSI learning on students' creative thinking skills in science learning.

## Result and Discussion

Articles were searched from the Google Scholar database. This search yielded 1,000 articles. Then, identification was carried out to find duplicate articles, resulting in 129 articles. A total of 871 articles with no similarities were then reviewed based on methodology and sources. The criteria for the articles were that they were written in Indonesian and English, were from journals and proceedings, and were not literature review studies. This screening process resulted in 691 articles that met the criteria. In comparison, 129 articles did not meet the criteria, consisting of 5 articles not written in Indonesian or English, 81 in book form, and 43 articles using the literature review method.

The screening process continued with reading the titles and abstracts. The selection of articles was based on several criteria, namely articles that were freely accessible (open access), articles related to the SSI approach, and articles that explained the relationship between SSI learning and creative thinking skills. The screening process resulted in 17 articles that met the criteria and 725 articles that did not. The 725 articles that

did not meet the criteria consisted of 73 inaccessible articles, 52 articles unrelated to SSI, and 600 articles that did not explain the relationship between SSI learning and creative thinking skills. After the lengthy screening process, 17 articles were selected for further analysis. Literature selection or journal review materials were conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) method. The PRISMA Flow Diagram in this study is shown in Figure 1.

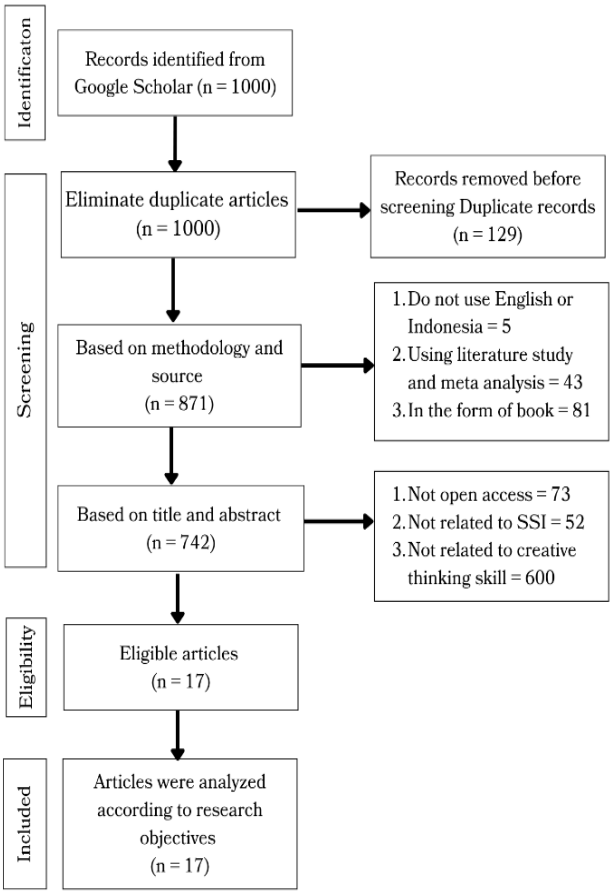


**Figure 1.** PRISMA diagram

Based on the PRISMA method, from 1,000 selected journals, a final result of 17 journals was obtained to be used as material for this literature review. Journals that met the criteria were synthesized by comparing the 17 journals according to the focus and objectives of the study related to "The implications of the SSI approach on students' creative thinking skills." The collected data were analyzed using a qualitative-descriptive approach. The findings from this review are supported by data showing that most of the reviewed articles include the author's name, title, and description of the findings. The articles used are appropriate for describing the implications of SSI on students' creative thinking skills in terms of models, approaches, methods, the presence of educators and learners, and learning activities.

The learning process that can shape 21st century skills, including students' creative thinking skills, is a learning process that uses contextual problems (Badeo & Duque, 2022; Sari et al., 2025). SSI involve using science topics to encourage students to engage in dialogue, discussion, and debate. These issues are generally controversial but require moral reasoning or evaluating ethical aspects in the decision-making process regarding the possible solutions offered. This approach aims to make the issues discussed personally meaningful and engaging for students. In addition, students are encouraged to use evidence-based reasoning and develop scientific understanding through contexts relevant to real life (Zeidler & Nichols, 2009). The SSI approach can significantly enhance students' creativity by engaging them in critical thinking, problem solving, and exploring various perspectives related to real-world challenges. Social science issues do not have definitive answers or fixed solutions but are open-ended (Zeidler et al., 2005). SSI based learning encourages students to analyze complex issues, develop innovative solutions, and consider scientific progress's ethical and social implications, thereby fostering creative thinking skills (Dusturi et al., 2024; Indriani & Jayanti, 2022).

These statements follow the results of the literature review conducted by the researcher, which shows that there have been several publications in the last five years related to the application of SSI based learning to students' creative thinking skills, as shown in Figure 2.

Figure 2 shows the distribution of articles based on the research methods used in applying the SSI approach to students' creative thinking skills between 2021 and 2025. The graph shows that quantitative research methods dominated throughout 2021–2025. This is indicated by the increasing number of quantitative articles, starting from 0 articles in 2021, then rising to 2 articles in 2022 and 2023, peaking at four articles in 2024, and decreasing to 2 articles in 2025. Additionally, the Research and Development (R&D) method began to emerge in 2023 with 1 article, increased to 2 articles in 2024, but did not appear again in 2025. Meanwhile, a smaller percentage is shown by qualitative research and mixed methods. Qualitative research only appeared in 2022 and 2024 with 1 article each, while mixed methods first appeared in 2024 and 2025 with 1 article each. The details of research methods using the SSI approach are shown in Table 2.

Based on the data analysis, quantitative research methods dominate with a significant upward trend. The most commonly used type of research is quasi-experimental research. It demonstrates cause and effect by manipulating independent variables (SSI approach) and observing their effects on dependent variables

(creative thinking skills). In addition to quantitative research, the implications of applying the SSI approach to creative thinking skills are also explored in the R&D method. This research focuses on developing various learning products, such as SSI based learning modules and creative thinking assessment instruments, within SSI. The results of this R&D research can provide alternative teaching materials and assessment instruments relevant to supporting the enhancement of students' creative thinking skills through SSI learning (Irwandani et al., 2024; Mulyono et al., 2023; Siregar et al., 2024). Meanwhile, a smaller percentage comes from qualitative and mixed-methods research that explores in greater depth how the SSI based learning process can facilitate the development of students' creative thinking skills and understand the dynamics of its implementation in the field (Harahap et al., 2022; Khoiri et al., 2024; Rezeki & Nugraha, 2024; Tasyani et al., 2025).

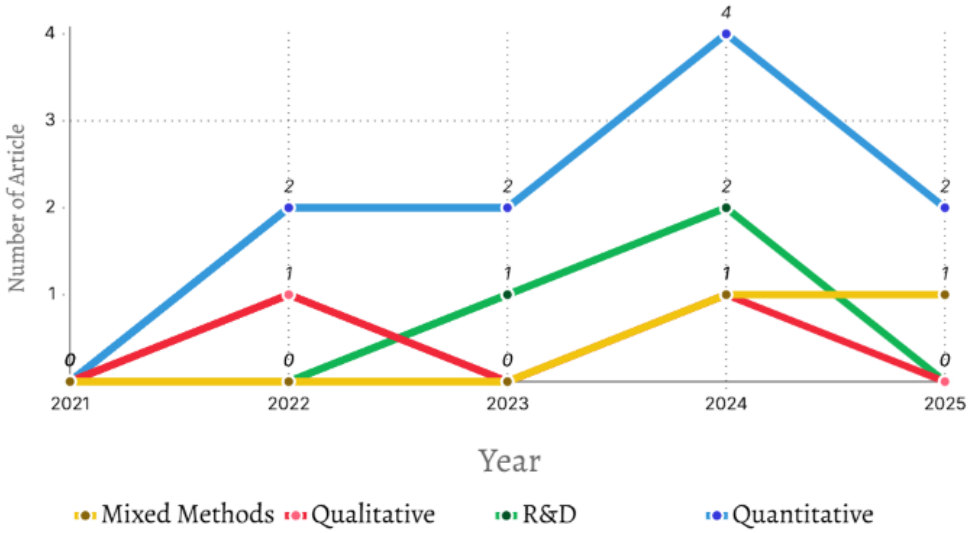


**Figure 2.** Research methods with socio-scientific issues

**Table 2.** Data on the number of article types by method

| Research Methods | Number of Articles | Percentage (%) |
|---|---|---|
| Quantitative | 10 | 58.8 |
| Qualitative | 2 | 11.8 |
| Research and Development | 3 | 17.6 |
| Mixed Methods | 2 | 11.8 |

A review of 17 analyzed articles reveals that the effectiveness of the SSI approach in science learning can be enhanced by integrating it with constructivist learning models, such as the Problem-Based Learning model to train problem-solving skills, the Project-Based Learning model for applied contexts, inquiry to foster curiosity, design thinking for innovation, and problem-solving for systematic analysis. This integration creates a holistic learning environment, encouraging students to connect SSI with creative STEM-based solutions. Applying the SSI approach positively enhances students' creative thinking skills in science education. This is evidenced by the improvement in creative thinking skills as demonstrated in the research findings from the analyzed articles (Andaresta & Irawan, 2025; Arifin & Siew, 2023, 2024; Diana et al., 2024; Khoiri et al., 2023, 2024; Piboon et al., 2024; Pursitasari et al., 2022; Satria et al., 2024; Zamri et al., 2025). This finding reinforces that the SSI approach provides a meaningful and relevant learning context for real life. It encourages students to think more flexibly and creatively when solving science problems (Zeidler, 2014). SSI are becoming increasingly important in science education for several reasons: they make science learning more relevant to students' lives; they serve as a vehicle for achieving educational outcomes, such as an appreciation for the nature of science; they enhance students' ability to express creative ideas through dialogue; and they strengthen the ability to evaluate scientific information (Sadler & Zeidler, 2004). For the SSI approach to be effective, it should be integrated with constructivist learning models such as Problem-Based Learning, Project-Based Learning, inquiry-based learning, and design thinking (Arifin & Siew, 2023; Khoiri et al., 2023; Rezeki & Nugraha, 2024; Zamri et al., 2025). This integration creates a strong connection between the philosophical foundation and practical implementation.

Philosophically, the SSI approach directs learning based on socially and scientifically relevant issues connected to real life, emphasizing values such as social responsibility and ethical reasoning (Zeidler & Nichols, 2009). However, without a clear operational framework, this approach risks becoming abstract for students. This is where constructivist learning models come into play,

providing structured steps (for example, the problem identification phase in PBL or the reflection cycle in the design thinking model) to transform SSI principles into measurable learning activities (Macalalag et al., 2020). For instance, when addressing the issue of global warming, the Project Based Learning model can guide students in designing community-based mitigation projects, while inquiry-based learning helps them critically explore scientific data. This integration enhances conceptual understanding and develops 2st century skills such as collaboration and systems thinking, making the learning experience more meaningful and contextual. This integration strengthens conceptual understanding and develops 21st century skills such as collaboration and systems thinking, making learning more meaningful and contextual (Ke et al., 2023).

SSI approach requires appropriate assessment instruments and learning resources to measure students' understanding while encouraging their engagement with complex and socially relevant scientific issues. The review of articles shows that essay tests have become the most developed and used assessment instrument for SSI to measure critical thinking, argumentation, and creative thinking skills in responding to real-world dilemmas. However, essay-based assessments should be complemented with other instruments such as structured rubrics, scenario-based questions, and peer assessments to comprehensively evaluate student learning outcomes (Irwandani et al., 2024; Mulyono et al., 2023). This is because problems in the context of SSI cannot be definitively answered with just a "yes" or "no" due to their procedural and conceptual connections with science. The teacher introduces the SSI that will be discussed, including their scientific aspects and the instructions or guidelines needed by the students (Rundgren et al., 2016).

The development of learning modules is crucial for guiding students to systematically explore SSI. According to the study by Pursitasari et al. (2022) these modules are designed to integrate case studies, guided inquiry activities, and reflection tasks, allowing students to connect scientific concepts with their social implications. Moreover, web-based platforms enhance the learning of SSI through interactive simulations, multimedia resources (such as videos and infographics), and online discussion forums where students can collaborate to analyze and debate current issues (Piboon et al., 2024). Additionally, digital technology facilitates adaptive learning, enabling students to study SSI independently while receiving immediate feedback (Karişan & Zeidler, 2024). This learning process empowers students to think openly and broadly, thereby helping them develop their creative thinking skills effectively.

## Conclusion

Based on the findings from the Systematic Literature Review, it can be concluded that the Socio-Scientific Issues (SSI) approach is an effective method for teaching science. This approach presents meaningful contexts that are relevant to real life and encourages students to develop their creative thinking skills. Research on the implementation of SSI primarily utilizes quantitative methods, followed by development research (Research and Development), with fewer studies employing qualitative or mixed methods. This indicates that SSI based learning not only helps students think flexibly, originally, and openly but also aids in the development of learning models and instruments relevant to the SSI context. Educators are advised to start integrating the SSI approach into science learning so that students are accustomed to examining current issues that require creative and critical thinking skills. Further studies can be focused on exploring the use of SSI-based digital applications or media, as well as implementing qualitative or mixed methods research in more depth to explore the dynamics of the learning process with the SSI approach. Thus, the application of SSI is expected to continue to develop as one of the learning strategies that supports strengthening students' creative thinking skills in the era of global challenges.

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The authors declare no conflict of interest.

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