Social, Humanities, and Educational Studies

SHEs: Conference Series 9 (1) (2026) 953 – 966

Socio-Scientific Issues Based Introduction (SSIBI) in Elementary School IPAS Learning: A Theoretical and Empirical Review

Septian Eko Rahmanto, Kartika Chrysti Suryandari, Endrise Septina Rawanoko

Universitas Sebelas Maret
kartika@fkip.uns.ac.id

Article History
accepted 1/2/2026 approved 1/3/2026 published 31/3/2026

Abstract
IPAS learning in elementary schools is still largely teacher-centered and insufficiently connected to real-life contexts, resulting in low conceptual understanding and limited student engagement. This study aims to examine theoretically and empirically the implementation of the Socio Scientific Issues Based Introduction (SSIBI) model in elementary school IPAS learning. The method employed is a literature review by analyzing various sources, including national and international journal articles, textbooks, and relevant previous studies related to the SSIBI model, socio-scientific issues–based learning, and conceptual understanding in IPAS. The analysis was conducted using a descriptive qualitative approach to identify theoretical foundations, model characteristics, and empirical findings regarding the effectiveness of SSIBI. The results of the review indicate that the SSIBI model is grounded in social constructivist theory and meaningful learning, encouraging students to construct conceptual understanding through discussion, analysis of real-world issues, and science-based decision making. Empirical evidence shows that the implementation of SSIBI is effective in improving students' conceptual understanding of IPAS, scientific literacy, critical thinking skills, and active participation in learning. In addition, the model produces nurturant effects in the form of strengthened scientific attitudes, social awareness, and student character development. Therefore, it can be concluded that the Socio Scientific Issues Based Introduction (SSIBI) model is an effective and relevant instructional approach for improving the quality of IPAS learning in elementary schools.
Keywords: *Socio Scientific Issues Based Introduction (SSIBI), IPAS learning, conceptual understanding, literature review, elementary school*

Abstrak
Pembelajaran IPAS di sekolah dasar masih sebagian besar berpusat pada guru dan kurang terhubung dengan konteks kehidupan nyata, sehingga mengakibatkan pemahaman konseptual yang rendah dan keterlibatan siswa yang terbatas. Studi ini bertujuan untuk menguji secara teoritis dan empiris implementasi model Pengenalan Berbasis Isu Sosio-Ilmiah (SSIBI) dalam pembelajaran IPAS di sekolah dasar. Metode yang digunakan adalah tinjauan pustaka dengan menganalisis berbagai sumber, termasuk artikel jurnal nasional dan internasional, buku teks, dan studi sebelumnya yang relevan terkait dengan model SSIBI, pembelajaran berbasis isu sosio-ilmiah, dan pemahaman konseptual dalam IPAS. Analisis dilakukan menggunakan pendekatan kualitatif deskriptif untuk mengidentifikasi landasan teoritis, karakteristik model, dan temuan empiris mengenai efektivitas SSIBI. Hasil tinjauan menunjukkan bahwa model SSIBI berlandaskan teori konstruktivis sosial dan pembelajaran bermakna, mendorong siswa untuk membangun pemahaman konseptual melalui diskusi, analisis isu dunia nyata, dan pengambilan keputusan berbasis sains. Bukti empiris menunjukkan bahwa implementasi SSIBI efektif dalam meningkatkan pemahaman konseptual siswa tentang IPAS, literasi ilmiah, keterampilan berpikir kritis, dan partisipasi aktif dalam pembelajaran. Selain itu, model ini menghasilkan efek pengasuhan berupa penguatan sikap ilmiah, kesadaran sosial, dan pengembangan karakter siswa. Oleh karena itu, dapat disimpulkan bahwa model Pengenalan Berbasis Isu Sosial Ilmiah (SSIBI) merupakan pendekatan pembelajaran yang efektif dan relevan untuk meningkatkan kualitas pembelajaran IPAS di sekolah dasar.
Kata Kunci: Socio Scientific Issues Based Introduction (SSIBI), pembelajaran IPAS, pemahaman konseptual, tinjauan pustaka, sekolah dasar

Social, Humanities, and Education Studies (SHEs): Conference Series p-ISSN 2620-9284
https://jurnal.uns.ac.id/shes e-ISSN 2620-9292

INTRODUCTION

Learning Natural and Social Sciences (IPAS) in elementary school plays a strategic role in building foundational scientific and social literacy among learners from an early age. In the Merdeka Curriculum, IPAS is designed as an integrated subject that aims to develop conceptual understanding, critical thinking skills, problem-solving abilities, as well as students' character and social awareness (Kemendikbudristek, 2022). Globally, Integrated Natural and Social Sciences (IPAS) learning has become an essential instrument for developing 21st-century competencies, not only emphasizing content mastery but also fostering social and emotional skills, scientific literacy, and global awareness in addressing complex real-world issues. In the Indonesian context, this subject becomes an essential instrument for facilitating the development of 21st-century competencies, not only based on content mastery but also on social and emotional skills. The emphasis on the interconnectedness between natural and social phenomena is expected to help students see the relationship between scientific and social phenomena holistically, enabling them to understand IPAS in a contextual manner. Furthermore, educators are expected to design learning that uses real-world problems as primary learning resources to stimulate active engagement and higher-order thinking skills among learners. This paradigm shows that IPAS is not merely a separate subject but serves as an integrative means to build scientific thinking that is critical, creative, and concerned with the environment and human life.

However, the practice of IPAS learning in elementary schools still faces various challenges**.** Several studies over the past eight years indicate that IPAS instruction is still dominated by conventional teacher-centered approaches that prioritize content delivery and emphasize rote memorization over deep understanding (Sanjaya, 2019; Widodo et al., 2020). Other research also finds *low levels of student engagement* in learning processes that should be active and meaningful, resulting in students tending to passively receive material without exploring phenomena around them. This problem is exacerbated by the lack of utilization of local contexts and relevant real-world issues in the design of IPAS learning. Teachers often default to relying on textbooks as the main source of learning without facilitating discussion, argumentation skills, or critical reflection on social or scientific issues. In this context, the learning process does not fully reflect the needs of 21st-century education, which emphasizes critical thinking, collaboration, and the ability to evaluate complex information.

These conditions have impacts on the low quality of conceptual understanding of IPAS among elementary school students. Research by Pratiwi and Fajar (2021) shows that many students can recall IPAS facts but experience difficulty when asked to explain concepts, analyze phenomena, or connect knowledge with environmental and social problems. This finding aligns with the results of the Programme for International Student Assessment (PISA), which reported that Indonesian students' science literacy remains low, particularly in aspects of scientific reasoning and contextual problem solving (OECD, 2019). Low science literacy presents a significant challenge for elementary education because science literacy involves the ability to connect scientific knowledge with everyday life experiences and contemporary relevant issues. Moreover, other studies suggest that integrating real-world contexts into science learning can significantly improve learners' literacy skills and conceptual application. For example, the Socio-Scientific Issues (SSI) approach has been reported to enrich science learning with more contextual and interdisciplinary content, with the potential to enhance student science literacy in more meaningful ways (Nikmatur Rohmaya, 2023; Teaching Socioscientific Issues, 2025).

In addition to cognitive aspects, IPAS learning is also considered not yet optimal in fostering scientific attitudes, social concern, and students' responsibility toward problems around them. Global challenges such as climate change,

environmental pollution, waste management, clean water crises, and public health issues are real problems increasingly close to children's lives (UNESCO, 2021). These issues require critical thinking skills and the ability to argue and make decisions based on strong scientific evidence. IPAS learning that does not connect concepts with these issues risks making learners less sensitive to social and environmental problems and less capable of making science-based decisions. Therefore, a learning approach is needed that can authentically integrate social and scientific contexts so that learners can become responsible and adaptive problem solvers. The Socio-Scientific Issues (SSI) approach offers an opportunity to overcome these limitations by providing students with space to think critically within the context of real-world problems.

Various recent studies emphasize the importance of contextual science learning that is relevant to students' lives**.** Contextual learning allows learners to build meaning through direct experience and reflection on problems they face (Hidayat & Rahmawati, 2020). From a constructivist perspective, knowledge is not passively transferred from teacher to student but is actively constructed through social interaction and meaningful learning experiences (Schunk, 2020). Relevant contexts include social and environmental issues that are part of students' everyday lives, so learning not only emphasizes cognitive aspects but also affective and social ones. Additionally, contextual learning opens opportunities for learners to develop higher-order thinking skills, such as analysis, synthesis, and evaluation, which are crucial 21st-century competencies. The Socio-Scientific Issues approach has been widely recommended because it places real issues as a foundation for learning and enables the integration of various dimensions of knowledge in a meaningful way.

One approach considered relevant for addressing these challenges is Socio-Scientific Issues-based learning (SSI). Socio-scientific issues are defined as real-world problems that are open-ended, complex, and involve aspects of science, technology, and social or moral values (Zeidler, 2014). Research over the past eight years shows that the SSI approach is widely recommended as an effective strategy for improving science literacy, critical thinking, and decision-making skills among learners (Sadler et al., 2018; Zeidler et al., 2019). SSI offers students the opportunity to consider multiple perspectives when facing issues without a single correct answer, thereby stimulating students' argumentation skills and evaluation of scientific evidence. Other research in educational contexts shows that integrating SSI into science learning can provide deeper learning experiences and connections between academic content and real-life phenomena. This suggests that SSI not only enriches learning content but also expands students' participation in authentic scientific–social dialogue.

SSI-based learning positions students as active participants who engage in discussion, information analysis, and evaluation of various viewpoints on a given issue. Through this process, students not only learn scientific concepts but also develop argumentation skills, social empathy, and ethical awareness (Topçu et al., 2018). Research by Lee and Witz (2020) shows that integrating socio-scientific issues in science education can significantly increase student engagement and conceptual understanding. Moreover, contemporary studies emphasize that engagement with SSI helps students see the connection between scientific knowledge and complex social challenges and increases awareness of the value and ethical implications involved in problem solving. However, the implementation of SSI also requires teacher readiness to design authentic learning experiences that support active student involvement. This calls for adaptive pedagogical strategies and relevant learning resources aligned with the issues raised.

In the context of elementary education, socio-scientific issues must be pedagogically adapted to fit the cognitive and social development characteristics of young learners. One learning model that adapts the SSI approach at the early stages of learning is the Socio-Scientific Issues Based Introduction (SSIBI) model. SSIBI

places socio-scientific issues as an introduction to learning to build curiosity, activate prior knowledge, and motivate learners before they study core concepts (Nuangchalerm, 2018). This approach gives students the opportunity to connect their experiences with scientific phenomena directly, thus laying the foundation for critical thinking from an early age. It also encourages collaboration in investigating issues that have complex scientific, social, and ethical dimensions, fostering collaborative and scientific communication skills. Furthermore, SSIBI can help learners develop a multi-dimensional understanding of IPAS concepts that is holistic and relevant to daily life, aligning with the demands of 21st-century education that emphasize complex, reflective thinking and social responsibility.

However, the urgency of implementing SSIBI is reinforced by findings from previous studies indicating that IPAS learning in elementary schools still tends to focus on memorization and fragmented content delivery, resulting in low conceptual understanding, limited scientific literacy, and minimal student involvement in meaningful inquiry processes. Although numerous studies have explored socio-scientific issues (SSI)–based learning, most of them are conducted at the secondary or higher education levels, with relatively limited attention given to its adaptation in elementary education, particularly in the introductory phase of learning. In addition, prior research has largely emphasized learning outcomes such as critical thinking and scientific literacy, while studies specifically examining how SSI-based introductory models like SSIBI contribute to the development of conceptual understanding in IPAS at the elementary level remain scarce. Therefore, there is a clear research gap regarding the theoretical and empirical exploration of SSIBI as an instructional model that is developmentally appropriate for young learners and effective in improving conceptual understanding within elementary IPAS learning contexts.

METHOD

This study employed the Systematic Literature Review (SLR) method as the primary approach to identify, evaluate, and synthesize findings from primary studies relevant to the topic of Socio Scientific Issues Based Introduction (SSIBI) in Natural and Social Sciences (IPAS) learning in elementary schools. The SLR approach was chosen due to its capacity to produce a systematic, transparent, and comprehensive academic synthesis of available scholarly literature, enabling researchers to answer research questions objectively and with minimal bias. To enhance transparency, reproducibility, and to reduce reporting bias, the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) protocol was used as the guiding framework for conducting the review. PRISMA provides structured guidance on search strategy, selection criteria, and synthesis methodology, thereby ensuring that database searches, literature screening, and data analysis are performed meticulously and thoroughly so that the review results are scientifically accountable and replicable by other researchers in elementary education and science education contexts. The procedural application of this method aligns with SLR practices previously applied in primary education studies that also adopted systematic article selection based on PRISMA. The objective of this study is to systematically examine and synthesize theoretical foundations and empirical evidence regarding the implementation of the SSIBI model in elementary IPAS learning, particularly in relation to its effectiveness in improving students' conceptual understanding, scientific literacy, critical thinking skills, and active participation, as well as to identify research gaps and provide recommendations for future studies and instructional practices.

The SLR process began with the establishment of inclusion and exclusion criteria which included scholarly journal articles published within the last eight years (2018–2025), available in full text, and focusing on studies of socio-scientific issue-based learning models, SSIBI, or contextual learning concepts at the elementary

level. These criteria were designed to ensure that the literature analyzed was methodologically and contextually relevant and reflected the latest trends in IPAS research. Limiting the selection to indexed and full-text articles helped ensure the academic quality of the data analyzed, so that the synthesized findings would be based on strong empirical evidence and could be tested again — in line with SLR applications in other primary education reviews. Terms related to *socio-scientific issues*, *elementary education*, *science learning*, and other relevant keywords were carefully selected to minimize potential bias due to variations in international and local terminology. Articles that did not meet these criteria were automatically eliminated in the initial stages, maintaining the focus and effectiveness of the review process in accordance with standard practices for systematic literature screening.

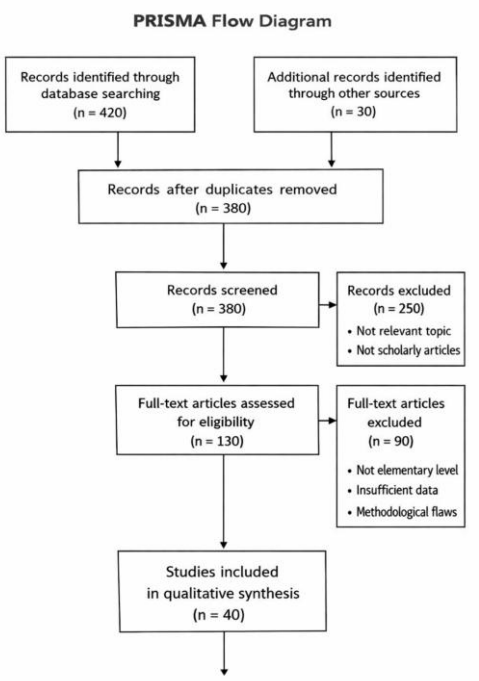
After the initial literature search, the collected articles were stored and managed using reference management software such as Zotero or Mendeley to facilitate citation management and automatic duplicate checking. This step was critical because searching through multiple databases often yields identical or closely similar documents, requiring deduplication to produce a clean and valid dataset. Effective bibliographic management also supported detailed documentation of methodological decisions, making subsequent steps more systematic and well-documented. The next stage involved screening based on titles and abstracts, where clearly irrelevant articles were further excluded to maintain consistency with the research focus. Articles that passed this screening were then read in full text to assess *eligibility*, aiming to ensure that the content was directly related to socio-scientific issue-based learning or the SSIBI model in elementary schools. This process was repeated to ensure the quality of the included articles while recording reasons for excluding unfit articles and documenting the entire selection process transparently and systematically.

During data extraction, the selected articles were systematically coded based on predetermined variables such as article title, author, year of publication, research objectives and design, methods used, main findings, and relevance to the SSIBI model. This extraction was documented in a structured summary table that included categories such as research type (qualitative, quantitative, or mixed), educational context, and outcome variables analyzed, thereby facilitating the subsequent data synthesis. All articles were analyzed to assess research trends, methodological quality, and empirical results related to the application of the SSIBI model or socio-scientific issues in elementary IPAS education. This information was then used to create a comprehensive overview of the state of research within the defined publication range, providing a strong foundation for discussing pedagogical phenomena and identifying research gaps that need prioritization in the future. Thus, this literature review process helped to identify future research directions in the field and to map issues consistently and relevantly as a basis for further development of educational theory and practice.

In the analysis of the literature data, the researcher applied a thematic synthesis approach to identify key themes emerging from the reviewed studies, including research design, educational context, results related to conceptual understanding of IPAS, science literacy, critical thinking skills, and challenges in SSIBI implementation. The analysis phase began with a comprehensive reading of the selected articles' content, followed by categorizing relevant information into emergent themes, which helped connect heterogeneous study results into a coherent and meaningful narrative. These themes were then compared critically to obtain a comprehensive picture of previous research conditions, existing gaps or limitations, and potential directions for future research in both elementary and broader science education contexts. The thematic synthesis also involved grouping data based on conceptual similarities and methodological differences so that patterns could be interpreted logically and systematically. The synthesis results were presented

narratively and *diagrammatically* to clearly and consistently show the main trends and findings from the analyzed articles.

To ensure the validity and reliability of the SLR results, the review process was supplemented with mechanisms for triangulation across literature sources and critical re-examination of each analyzed article to ensure consistency of interpretation and to reduce the possibility of selection or interpretation bias. Triangulation was performed by comparing synthesis results across various articles from different contexts and methods, so that the emerging patterns were not only consistent but also robust across methodological variations. The researcher also conducted cross-checks of the extracted information with the summary table data to minimize interpretation errors or bias during the data analysis stage. This approach ensured that the included articles were truly aligned with the research criteria and objectives, strengthening the conclusions drawn based on scientific evidence. Consequently, the SLR method applied in this study produced a literature summary that was valid, well documented, and relevant to the developments in eight years of research on the SSIBI model in elementary IPAS learning. Moreover, the SLR report is expected to serve as a comprehensive reference that will contribute to theory development, teaching practice, and future research agendas in primary education.



RESULTS AND DISCUSSION

This section presents the key findings from a systematic literature review related to socio-scientific issues (SSI) and their relevance to Natural and Social Sciences (IPAS) learning in elementary schools, as well as the relationship between those findings and established learning theories and prior empirical research. The literature analysis shows that SSI has become an important pedagogical approach in science education due to its ability to connect scientific content with real-world social issues that stimulate critical thinking, scientific argumentation, and evidence-based decision making. A comprehensive review titled *Teaching Socioscientific Issues: A Systematic Review* conducted by Högström, Gericke, et al. confirms that SSI has the potential to develop higher-order thinking skills—such as argumentation, decision

making, and critical reasoning—that contribute to student science literacy, even though its classroom implementation still faces practical challenges in everyday teaching practice. The review also finds that although many theoretical studies examine SSI, the actual practice of SSI in classrooms remains limited and often focuses primarily on ecological or environmental content, indicating a need to expand its application to other topics such as health, technology, and social ethics.

Further findings from the systematic literature review reveal that SSI has been extensively examined concerning science literacy, a critical competency in 21st-century education. For example, a study by Rohmaya (2022) using an SLR guided by PRISMA reports that science learning based on SSI contributes to improvements in student science literacy because students are not only learning factual content but also trained to connect scientific concepts with complex real-world problems such as environmental change and technological issues. Complementing this insight, another literature review on instructional materials integrating SSI found that contextual use of SSI helps learners construct meaning from scientific knowledge through relevant contextual experiences, as well as develop critical thinking skills useful in real life. These findings are consistent with claims from contextual learning theory which state that learning that connects academic knowledge with real-life situations is more meaningful and results in greater student engagement and deeper understanding. Taken together, this means that SSI has significant potential to raise the quality of science literacy among elementary students when designed with appropriate pedagogical strategies.

In addition to its effects on literacy, the literature also indicates that SSI contributes to the development of students' argumentation skills and critical thinking**.** For instance, research developing SSI-based instructional materials to facilitate written argumentation found that traditional learning often leaves students at basic levels of reasoning without supporting evidence, whereas SSI helps students engage in constructing evidence-based arguments. The emphasis on argumentation aligns with broader research on SSI and science education, which shows that SSI helps students analyze problems, evaluate the credibility of information, and formulate appropriate solutions, thereby strengthening scientific literacy and reasoning skills in learning contexts such as chemistry. These outcomes are important because they reflect core objectives of science education that extend beyond memorizing facts toward helping students apply scientific understanding in societal contexts.

The literature also highlights the breadth of SSI topics that have been examined. Scoping reviews of SSI research show that this approach is widely used in science education lessons to integrate real-world problems, promote critical thinking, and encourage interdisciplinary learning, particularly in areas such as environmental issues, genetics, and health-related concerns. These themes are frequently embedded in SSI research because they represent complex challenges that require students to connect scientific knowledge with social implications, thus fostering a holistic understanding of science's impact on people and society**.** Despite the demonstrated benefits, the literature also identifies key challenges in SSI implementation**.** For example, a systematic review of teachers' perceptions, challenges, and coping strategies in teaching SSI reveals that science teachers often hold partial understandings of SSI-based instruction and lack concrete strategies to effectively implement it. This highlights a consistent theme in SSI research: while theoretical and research perspectives recommend SSI for science education, there remains a gap between theoretical endorsement and classroom practice**.** Indeed, much of the existing research points to the need for professional development, teacher preparation, and instructional support that enable educators to integrate SSI into teaching practices meaningfully.

Another area of discussion emerging from the literature concerns the development of science literacy through SSI contexts**.** Several studies demonstrate

that SSI contexts can improve students' capacity to understand and solve problems that are relevant to their communities, further supporting the idea that SSI not only enhances academic competence but also empowers students to participate meaningfully in societal discourse. This indicates that SSI can nurture citizenship competencies, such as the ability to critically analyze information, consider ethical dimensions, and make decisions that reflect socially responsible thinking. Overall, the synthesis of literature shows that SSI has strong potential to contribute to multiple dimensions of student learning, particularly in enhancing science literacy, fostering critical thinking, and promoting argumentation skills within a broader socio-scientific context. However, it also suggests that continued research is needed to bridge the gap between theoretical frameworks and practical implementation, especially in elementary education settings where age-appropriate adaptations and teacher support systems are crucial. Future research could explore how SSI practices can be implemented more broadly across diverse science topics, how teachers' instructional confidence can be strengthened, and how evidence-based professional development programs can support effective SSI integration in elementary classrooms.

Table 1. Summary of SSI Impact Findings on Science Literacy and Student Skills

Study	Population	SSI Focus	Key Findings
Rohmaya (2022)	School students	SSI in science (IPA)	SSI in science learning improved students' science literacy through reflective thinking based on real-world issues.
Nurhalimah et al. (2024)	Literature review articles	SSI in science education	SSI was found to enhance scientific literacy and students' critical thinking skills, including scientific argumentation and conceptual understanding.
Fitriyani & Susiyawati (2023)	Junior high school students	SSI vs non-SSI	SSI-based learning was more effective than non-SSI approaches in improving students' scientific literacy.
Permatasari & Aji (2024)	School students	PBL with SSI	Problem-Based Learning with SSI was effective in improving students' scientific literacy skills as it connected science concepts to real-world contexts.
Sulistina et al. (2023)	Chemistry learning	SSI in chemistry	SSI contributed significantly to enhancing scientific literacy, helping students analyze

			problems and evaluate scientific evidence.
Sadler & Zeidler (2005)	High school students	SSI-based instruction	SSI learning improved students' informal reasoning, moral reasoning, and scientific literacy when dealing with real-world scientific issues.
Zeidler et al. (2009)	Secondary students	SSI in science education	SSI enhanced scientific literacy by integrating ethical reasoning, argumentation, and socioscientific decision-making.
Sadler (2004)	High school students	SSI and argumentation	Engagement with SSI strengthened students' scientific argumentation skills and understanding of science in societal contexts.
Eastwood et al. (2012)	Secondary students	SSI & sustainability	SSI-based learning promoted scientific literacy, especially in evaluating evidence and making informed decisions about sustainability issues.
Khishfe (2012)	Middle school students	Nature of Science (NOS) & SSI	SSI instruction improved students' understanding of NOS and scientific literacy through socioscientific reasoning.
Romine, Sadler, & Kinslow (2017)	High school students	SSI curriculum implementation	Combining SSI with inquiry learning enhanced students' scientific literacy and critical thinking skills.
Liu, Lin, & Tsai (2011)	High school students	SSI and decision-making	SSI-based learning improved students' scientific literacy and their ability to make informed socioscientific decisions.
Chen & Xiao (2021)	Secondary students	SSI in biology education	SSI instruction enhanced conceptual understanding, scientific reasoning, and literacy related to biological

			issues.
Foulk et al. (2020)	High school students	SSI & climate change	SSI-based climate change instruction improved scientific literacy, argumentation skills, and engagement with complex science issues.

The findings of the literature review indicate that *Socio-Scientific Issues* (SSI) contribute not only to the improvement of scientific literacy but also significantly influence the development of students' critical thinking and argumentation skills. Several studies examining the integration of SSI with *Problem-Based Learning* (PBL-SSI) reveal that this instructional model effectively enhances critical thinking. This is because students are required to identify real-world problems, analyze information, consider multiple perspectives, and formulate solutions based on scientific evidence. These findings are supported by systematic reviews demonstrating that the integration of PBL and SSI significantly improves critical thinking outcomes by engaging students in complex and meaningful real-life issues. In addition, the literature highlights that SSI plays an important role in strengthening students' scientific argumentation skills. The use of contemporary issues in the classroom encourages students to engage in evidence-based discussions that integrate social values and empirical data, thereby improving their scientific communication abilities.

Within the context of elementary education, empirical studies show that the integration of SSI into instruction has a positive impact on various student competencies. Quantitative research in elementary science classrooms indicates significant improvements in students' scientific literacy, particularly in their ability to analyze scientific phenomena within social contexts and make informed decisions to address complex problems. Furthermore, studies integrating SSI with structured inquiry approaches demonstrate that students achieve higher levels of higher-order thinking skills (HOTS) compared to those in traditional learning environments. Moreover, the use of SSI combined with various instructional models, such as guided inquiry, PBL, and contextual learning approaches, has been shown to enrich the learning process and enhance the quality of students' learning experiences. A systematic review of guided inquiry integrated with SSI reports positive effects on science process skills, including critical thinking and scientific argumentation, although further research is still needed to optimize this integration.

Regarding content trends, the literature reveals that environmental issues—such as climate change, ecosystems, energy resources, and biodiversity—are the most frequently used SSI contexts. These topics are highly relevant to students' daily lives and encompass complex scientific, social, and ethical dimensions, making them effective for contextual and meaningful learning. However, despite these positive outcomes, the literature also identifies several challenges in SSI implementation. Key issues include limited teacher readiness, insufficient instructional resources, and a lack of clear pedagogical guidance for effectively integrating SSI into classroom practice. These challenges indicate a gap between theoretical frameworks and practical implementation.

The findings of this study are consistent with social constructivist theory, which emphasizes that knowledge is constructed through social interaction, meaningful experiences, and reflection. The evidence that SSI enhances student engagement, critical thinking, and argumentation skills suggests that learning based on real-world issues facilitates active knowledge construction.

These results are also aligned with previous studies indicating that SSI-based *Problem-Based Learning* effectively improves critical thinking skills. Students' involvement in analyzing real-world problems and making evidence-based decisions reflects higher-order thinking processes, which are central to the objectives of IPAS education. Furthermore, the improvement in scientific literacy supports the principles of contextual learning theory, which emphasizes the importance of connecting academic content to real-life situations. The use of relevant issues, such as environmental and societal challenges, enables students to develop a deeper and more meaningful understanding of scientific concepts.

In terms of argumentation skills, the findings are consistent with prior research emphasizing the role of contemporary issues in promoting evidence-based discussion and scientific communication. SSI provides a platform for students to engage in discourse that integrates empirical evidence with social and ethical considerations. Nevertheless, the challenges identified in SSI implementation highlight that its effectiveness depends not only on instructional design but also on teacher readiness and the availability of adequate learning resources. This reinforces the commonly identified gap between theory and classroom practice. In this regard, the Socio-Scientific Issues Based Introduction (SSIBI) model offers a relevant solution. By positioning SSI at the introductory stage of learning, SSIBI is more developmentally appropriate for elementary students and easier for teachers to implement. It allows students to activate prior knowledge and build initial conceptual understanding through contextual issues before engaging with core scientific concepts. Therefore, SSIBI aligns with theoretical perspectives on active, meaningful, and reflective learning, while also addressing practical challenges identified in previous studies.

CONCLUSION

Overall, this systematic literature review shows that the Socio-Scientific Issues (SSI) approach plays an important role in improving IPAS learning, particularly in enhancing students' conceptual understanding, scientific literacy, critical thinking, and argumentation skills through real-world contexts. SSI also supports higher-order thinking, such as problem-solving and decision-making, by engaging students with complex and meaningful issues. In elementary education, the Socio-Scientific Issues Based Introduction (SSIBI) model is considered a promising approach, as it introduces socio-scientific issues at the beginning of learning to build motivation, activate prior knowledge, and support deeper understanding. However, several challenges remain, including limited teacher readiness, lack of instructional resources, and the need for more empirical studies at the elementary level.

Therefore, SSI and SSIBI have strong potential to improve the quality of IPAS learning, although further research and support for implementation are still needed.
Furthermore, the integration of SSI in learning reflects a shift toward more student-centered and contextual instruction, where students actively engage in analyzing real-life problems and constructing their own understanding. This approach aligns with the goals of modern education that emphasize meaningful learning and the development of 21st-century competencies. In addition, the use of relevant and authentic issues in SSIBI can increase students' engagement and participation, as learning becomes more connected to their daily experiences. This not only supports cognitive development but also fosters social awareness and responsibility among students.

Finally, to optimize the implementation of SSI and SSIBI, it is important to provide adequate support for teachers through professional development, as well as to develop appropriate learning materials and assessment tools. Such efforts are necessary to ensure that the potential of SSI-based learning can be effectively realized in elementary IPAS classrooms.

Moreover, strengthening collaboration between educators, researchers, and curriculum developers is essential to ensure that SSI and SSIBI are implemented effectively and sustainably. Such collaboration can support the development of innovative learning designs and evidence-based practices that are suitable for elementary school contexts. Lastly, continuous evaluation and refinement of SSI and SSIBI implementation are needed to ensure their effectiveness in improving learning outcomes. Ongoing research and classroom-based studies will play a crucial role in providing insights for improving instructional practices and ensuring that IPAS learning remains relevant to the evolving demands of society.

REFERENCES

Afrilya, N. A., Afrianis, N., & Nurhadi. (2022). Pengaruh penerapan pendekatan socio-scientific issues terhadap kemampuan literasi sains siswa pada materi minyak bumi. *Jurnal Riset Pendidikan Kimia, 12*(1), 10–19.

Arjaya, I. B. A., & Surata, S. P. K. (2024). A systematic review: Trends socioscientific issues in climate change materials. *Jurnal Santiaji Pendidikan (JSP).* https://doi.org/10.36733/jsp.v14i1.8666

Bencze, L., & Carter, L. (2011). Globalizing students acting for the common good. *Journal of Research in Science Teaching, 48*(6), 648–669. https://doi.org/10.1002/tea.20419

Bybee, R. W. (2013). *The case for STEM education: Challenges and opportunities*. NSTA Press.

Chen, Y., & Xiao, Y. (2021). Integrating socio-scientific issues into biology instruction to enhance students' scientific literacy. *Journal of Biological Education, 55*(4), 412–425. https://doi.org/10.1080/00219266.2020.1726994

Driver, R., Newton, P., & Osborne, J. (2000). Establishing the norms of scientific argumentation in classrooms. *Science Education, 84*(3), 287–312. https://doi.org/10.1002/(SICI)1098-237X(200005)84:3<287::AID-SCE1>3.0.CO;2-A

Eastwood, J. L., Sadler, T. D., Zeidler, D. L., Lewis, A., Amiri, L., & Applebaum, S. (2012). Contextualizing nature of science instruction in socio-scientific issues. *International Journal of Science Education, 34*(15), 2289–2315. https://doi.org/10.1080/09500693.2012.667582

Ester, K., Arnyana, I. B. P., & Margunayasa, I. G. (2025). Systematic literature review (SLR): Kebijakan pendidikan dalam pembelajaran di sekolah dasar. *Pendas: Jurnal Ilmiah Pendidikan Dasar.*

Evagorou, M., & Osborne, J. (2013). Exploring young students' collaborative argumentation within a socioscientific issue. *Journal of Research in Science Teaching, 50*(2), 209–237. https://doi.org/10.1002/tea.21076

Fitriyani, A., & Susiyawati, E. (2023). Pembelajaran IPA berbasis socio-scientific issues untuk meningkatkan kemampuan scientific literacy siswa SMP. *Eksakta: Jurnal Penelitian dan Pembelajaran MIPA.*

Fitriyani, R., & Susiyawati, E. (2023). The effectiveness of socio-scientific issues-based learning on students' scientific literacy. *Journal of Science Learning, 6*(2), 123–131.

Foulk, J. A., Friedrichsen, P., Sadler, T. D., & Sonnert, G. (2020). Teaching climate change through socio-scientific issues: Effects on student engagement and scientific literacy. *Science Education, 104*(6), 1036–1063. https://doi.org/10.1002/sce.21587

Fuadina, N., Aisyah, S., & Prassasty, A. (2024). Systematic literature review: Implementasi media bimbingan dan konseling dalam pendidikan dasar. *Jurnal Studi Pendidikan Dasar, 2*(2), 367–376.

Habibah, R. I., Nuraini, A., & Wahyuningsih, Y. (2025). Systematic literature review dengan metode PRISMA: Peran pembelajaran IPS dalam mengembangkan karakter siswa. *Didaktik: Jurnal Ilmiah PGSD STKIP Subang.*

Huda Arrofi', M. (2024). Systematic literature review (SLR): Implementasi moderasi beragama di sekolah dasar. *Literasi: Jurnal Kajian Keislaman Multi Perspektif, 4*(2).

Indraswari, A. W., & Wahyuni, S. (2025). Content analysis of socio scientific issues research in physics learning 2020–2025: Systematic literature review. *Lontar Physics Today.*

Irsan, I. (2023). Implementasi literasi sains dalam pembelajaran IPA di sekolah dasar. *Jurnal Basicedu, 5*(6), 1682.

Khishfe, R. (2012). Relationship between students' understanding of nature of science and their decision-making on socio-scientific issues. *International Journal of Science Education, 34*(10), 1491–1514. https://doi.org/10.1080/09500693.2011.626557

Lederman, N. G. (2007). Nature of science: Past, present, and future. In *Handbook of Research on Science Education* (pp. 831–879).

Liu, S. Y., Lin, C. S., & Tsai, C. C. (2011). College students' scientific epistemological views and thinking patterns in socio-scientific decision making. *Science Education, 95*(3), 497–517. https://doi.org/10.1002/sce.20422

Neli Wisdayana, A. A., Rahman Aththibby, A. R., & Pratiwi, D. (2025). Integrasi literasi sains pada bahan ajar berbasis socio-scientific issues. *Jurnal Pendidikan MIPA, 15*(1).

Noviar, D., Suyanto, S., & Suhartini, S. (2024). A systematic literature review of socioscientific issues in science education: Integration and instructional effect in science learning. *International Proceeding Annual International Conference Education Research, 1*(2), 161–173.

Nurhalimah, S., Putri, R. A., & Widodo, A. (2024). Socio-scientific issues in science education: A systematic literature review. *Journal of Science Education Research, 8*(1), 45–58.

Osborne, J., Erduran, S., & Simon, S. (2004). Enhancing the quality of argumentation in school science. *Journal of Research in Science Teaching, 41*(10), 994–1020. https://doi.org/10.1002/tea.20035

Permatasari, D., & Aji, S. (2024). Penerapan problem-based learning berbasis socio-scientific issues terhadap scientific literacy skills siswa. *Proceedings Seminar Nasional IPA.*

Permatasari, D., & Aji, S. D. (2024). Problem-based learning integrated with socio-scientific issues to improve students' scientific literacy. *Journal of Science Learning, 7*(1), 22–30.

Presley, M. L., Sickel, A. J., Muslu, N., Merle-Johnson, D., Witzig, S. B., Izci, K., & Sadler, T. D. (2013). A framework for socio-scientific issues-based education. *Science Educator, 22*(1), 26–32.

Qu, L. (2023). Pre-service primary school teachers' view of nature of science helps decision making on socio-scientific issues. *Science Insights Education Frontiers.*

Roberts, D. A., & Bybee, R. W. (2014). Scientific literacy, science literacy, and science education. In *Handbook of Research on Science Education* (Vol. 2). Routledge.

Rohmaya, R. (2022). Socio-scientific issues-based science learning to improve students' scientific literacy. *Journal of Science Education, 6*(3), 201–210.

Romine, W. L., Sadler, T. D., & Kinslow, A. T. (2017). Assessment of scientific literacy through socio-scientific issues. *International Journal of Science Education, 39*(8), 940–961. https://doi.org/10.1080/09500693.2017.1306594

Sadler, T. D. (2004). Informal reasoning regarding socioscientific issues: A critical review of research. *Journal of Research in Science Teaching, 41*(5), 513–536. https://doi.org/10.1002/tea.20009

Sadler, T. D. (2011). *Socio-scientific issues in the classroom: Teaching, learning and research*. Springer.

Sadler, T. D., & Zeidler, D. L. (2005). Patterns of informal reasoning in the context of socioscientific decision making. *Journal of Research in Science Teaching, 42*(1), 112–138. https://doi.org/10.1002/tea.20042

Sadler, T. D., et al. (2025). Teaching socioscientific issues: A systematic review. *Science & Education, 34*, 3079–3122. https://doi.org/10.1007/s11191-024-00542-y

Setiawardani, W., & Mahmudiyah, R. (2025). Pengembangan kurikulum sekolah dasar untuk menumbuhkan jiwa kepemimpinan anak: Systematic literature review. *Pendas: Jurnal Ilmiah Pendidikan Dasar.*

Sholehah, A., Pertiwi, A. D., & Yudianti, F. (2023). Studi literatur penggunaan pendekatan socio-scientific issue untuk membentuk generasi Indonesia yang kritis. *ScienceEdu: Jurnal Pendidikan S1 UNEJ.* https://doi.org/10.19184/se.v5i2.31257

Simonneaux, L., & Simonneaux, J. (2012). Educational configurations for teaching environmental socioscientific issues. *Science Education International, 23*(1), 37–54.

Siringo Ringo, S. (2025). Systematic literature review dengan metode PRISMA: Pembelajaran berdiferensiasi pada pendidikan dasar. *Jurnal Didaktika Pendidikan Dasar, 9*(1), 209–226. https://doi.org/10.26811/didaktika.v9i1.1760

Siti Nurhalimah, Latip, A., & Purnamasari, S. (2024). Analisis pendekatan socio-scientific issues (SSI) dalam pembelajaran IPA terhadap literasi saintifik. *Pendas: Jurnal Ilmiah Pendidikan Dasar.* https://doi.org/10.23969/jp.v9i2.13540

Sulistina, O., Rahmawati, Y., & Permanasari, A. (2023). Implementation of socio-scientific issues in chemistry learning to enhance scientific literacy. *Journal of Chemical Education, 100*(4), 1523–1531.

Wati, F. P., & Wulandari, F. (2024). The effect of socio-scientific issues-based learning on elementary school students' scientific literacy abilities. *Eduproxima: Jurnal Ilmiah Pendidikan IPA.*

Wisdayana, N., Achyani, A., Aththibby, A. R., & Pratiwi, D. (n.d.). Integrasi literasi sains pada bahan ajar berbasis socio-scientific issues. *Jurnal Pendidikan MIPA.* https://doi.org/10.37630/jpm.v15i1.2164

Zeidler, D. L., Sadler, T. D., Simmons, M. L., & Howes, E. V. (2009). Beyond STS: A research-based framework for socio-scientific issues education. *Science Education, 93*(5), 796–825. https://doi.org/10.1002/sce.20331

Zulfahmi, Z., Kurnia, R., Ramadhan, M. R. A., & Khairi, M. D. (2025). Systematic literature review: Problematika kompetensi guru sekolah dasar dan upaya peningkatan mutu pendidikan. *Jurnal Basicedu, 9*(6). https://doi.org/10.31004/basicedu.v9i6.10905