Lontar Physics Today (e-ISSN: 2828-0970)
Vol. 4 No. 3 November 2025, p 142-150
Available online at http://journal.upgris.ac.id/index.php/upt
DOI: 10.26877/lpt.v4i3.24894.

# Content Analysis of Socio-Scientific Issues Research in Physics Learning 2020-2025: Systematic Literature Review

**Anisa Wulan Indraswari and Siti Wahyuni***

*Department of Physics Education, Universitas Negeri Semarang, Semarang, Central Java, Indonesia.*

* Corresponding author(s), e-mail: wahyuni.smg@mail.unnes.ac.id

**Article Info:**

**Article History:**
Received: 7 September 2025
Accepted: 15 October 2025

**Keyword:**
Physics education, Socio-scientific issues, Systematic Literature Review

**Abstract:**

This study aims to identify trends and directions of studies related to the socio-scientific issues (SSI) approach in physics education. Using the Systematic Literature Review (SLR) method, 11 articles published between 2020-2025 were analyzed through a bibliometric approach and content analysis. The results show that the SSI approach is not only utilized as a learning strategy, but also as a transformative tool that integrates cognitive, affective, and social values aspects. Energy topics and environmental issues dominate the learning context, while other physics topics such as waves and modern physics are less explored. In addition, there is a tendency to apply SSI at the high school level, which is considered more cognitively prepared and reflective. This research recommends diversifying the context of SSI and strengthening teachers' capacity in designing contextual and meaningful physics learning in the post-pandemic era.

## 1. Introduction

Socio-scientific issues (SSIs) are referred to as "real world scenarios related contemporary issues" because they integrate science learning with real social, cultural, political, and ethical problems [1]. There are several characteristics that make SSI relevant in science education such as being complex, unstructured, and involving multiple perspectives [2]. As a contextual learning framework, SSI enables students to analyze scientific issues related to real-world ethical, political, or social dilemmas, thus increasing the relevance and authenticity of science learning [3]. This process encourages students to think critically through exploration of the issues studied from various perspectives, accompanied by in-depth analysis [4].

The SSI approach in science education is evolving into a pedagogical approach in fostering students' scientific literacy and social awareness [5]. In the last decade, various countries have begun to integrate SSI as an important component in the curriculum, pedagogy and research of science education around the world [6]. SSI also promotes learning that is in line with the demands of the 21st century through inquiry-based and transdisciplinary learning by integrating science, social values, and democratic participation [7]. Therefore, learning the SSI approach not only deepens students' scientific insights, but also strengthens social ethical aspects in the context of education [8]. Science education, especially physics, has a significant impact on the development of students' scientific skills and literacy, if packaged in a relevant and applicable context [9].

The application of Socio-Scientific Issues (SSI) approach in physics learning can help students link physics concepts with phenomena in everyday life and train critical thinking skills through scientific processes such as observation, hypothesis generation, testing, and conclusion drawing [10]. However, physics learning is often considered difficult by students due to its abstract concepts, complex systems, limited prior knowledge, and the use of confusing symbols that trigger misconceptions that hinder students' conceptual understanding [11]. In this context, the SSI approach provides a pedagogical solution by presenting relevant real contexts, thus enabling students to understand the linkages between physics concepts and social issues [12]. Physics concepts such as climate change, renewable energy is one of the real examples that can be studied through the SSI approach [13]. SSI implementation in physics learning not only improves science literacy, but also helps students connect physics concepts with real-life contexts and complex social issues, so that learning becomes more meaningful [14].

In recent years, there has been increasing attention to research that addresses the application of Socio-Scientific Issues (SSI) in education. However, studies that specifically explore the integration of SSI in the context of physics learning are still relatively limited compared to other science fields, such as biology and environmental issues. In fact, the SSI approach has great potential to bridge abstract physics concepts with real problems in society [15]. Therefore, this study uses content analysis to identify specific characteristics of data systematically, and objectively to help classify and understand the content of the communication under study [16]. The study was conducted through a review of the variables studied, the physics materials used, the research methods, and the data collection tools. This study seeks to produce a comprehensive synthesis related to the

utilization of SSI. The information is expected to provide a comprehensive picture of the development of SSI research in physics education, as well as an important reference for the development of research and learning practices that are more contextual, transformative, and relevant to the needs of the 21st century.

This research aims to fill the gap in the literature review related to the implementation of Socio-Scientific Issues (SSI) in physics learning by conducting a systematic review of various studies that have been published during the period 2020 to 2025. A content analysis approach is used to compile an in-depth synthesis, which not only describes trends but also reveals the potential contribution of SSI in realizing more contextual and meaningful physics learning [17]. The findings of this study are expected to serve as a foundation for researchers, educators, and curriculum developers in expanding the scope of SSI utilization in physics education. The research questions used in this study were compiled based on the results of screening and analysis of various Scopus indexed scientific articles, as follows:

1. What are the main findings of the researches on the application of SSI in physics learning in the last five years?
2. What is the distribution of ssi research publications in physics learning based on the year of publication?
3. Which physics materials or topics are most associated with SSI?
4. Which SSI issues are most widely used in physics learning contexts?
5. What are the research objectives put forward in studies that integrate SSI in physics learning?
6. At which level of education is the SSI approach most widely applied in the context of physics learning?
7. What are the dependent variables studied in the research study of the application of SSI in physics education?

## 2. Method

### 2.1. Research Design

The method used is a systematic literature review that aims to collect, identify and deeply analyze relevant studies in order to present the latest literature updates. The data analysis employed content analysis methodology. An analysis of various data, such as visual and verbal data that allows the reduction of phenomena into defined categories in order to be better analyzed [18]. This process transforms publications into units of analysis that are coded with measurable categories, thus enabling an assessment of their appropriateness to the SLR research focus [19]. Thus, this design enables thorough knowledge mapping and a more systematic and targeted presentation of findings in response to the research focus.

### 2.2. Sample in the Study

This study uses a sample of 11 publication articles taken from the Scopus database, with all publications selected based on the specified keywords and focusing on the topics of "socio", "scientific", "issues", 'physics', "learning OR education". The publications included journal articles and conference proceedings Scopus was chosen over other databases such as Web of Science, Google Scholar, or ERIC because it provides broader coverage of high-quality publications that have undergone peer review, thereby ensuring the reliability of the data and relevance of the selected sources.

### 2.3. Research Procedure

The articles used in this study were obtained from the Scopus database. Scopus was chosen due to its broad, high-quality, and internationally recognized coverage of scientific literature. In the context of this study, a literature search on the Scopus database resulted in a number of articles related to the topics "socio", "scientific", "issues", 'physics', "learning OR education". From these results, 11 articles were selected as samples based on inclusion criteria such as relevant articles and conference proceedings and certain exclusion criteria such as those that include book chapters and publications that are not relevant to the field of physics learning. However, this relatively small sample size also represents a limitation, as most of the retrieved articles focused on science education in general, while only a limited number specifically addressed physics learning. This limitation also reflects the scarcity of research specifically addressing physics learning, underlining the relevance of this study in filling that gap.

### 2.4. Data Inclusion and Data Exclusion Criteria

All articles identified were in English. The inclusion criteria included research articles and proceedings articles that specifically addressed the application of Socio Scientific Issue (SSI) in physics learning. Articles that were not relevant to the research focus were excluded from the analysis using Convidence with the interval 2020-2025. In the screening process through Convidence, some articles were categorized as wrong scope, limited access. However, there are several articles found through keyword searches mentioning the topics "socio", "scientific", "issues", 'physics', "learning OR education", many of which do not directly discuss the application of SSI in the context of physics learning. Some articles discuss SSI in science education in general without linking it specifically to physics learning. In addition, some relevant articles have limited access, limiting the completeness of data that can be thoroughly analyzed. Presentation of data screening criteria, presented in Table 1.

**Table 1.** *Inclusion and Exclusion Data Criteria*

| Criteria | Data Inclusion | Data Exclusion |
|---|---|---|
| Language | English | Non-English |
| Article Type | Articles, Conference Papers, and Reviews | Editoria, Book Chapters, Thesis/Dissertation, and Technical Reports |
| Time Range | 2020 - 2025 | Beyond 2020-2025 |
| Open Access | All | Green, Hybrid Gold, Bronze |

### 2.5. Eligibility Criteria

The articles reviewed were determined based on systematically formulated inclusion and exclusion data criteria. The database of articles met the criteria if they were written in English, published in the form of journal articles or proceedings, and specifically discussed the application of Socio-Scientific Issues (SSI) in physics learning. Conversely, articles that were not relevant to the focus of the study, such as those that only discussed SSI in general in the context of science education without a direct link to physics learning, were excluded from the analysis. The screening process was conducted with the help of Covidence software, which automatically classified inappropriate articles into categories such as wrong scope and limited access. In addition, although some articles included keywords such as "socio", "scientific", "issues", "physics", and 'learning' or "education", not all of them explicitly examined the application of SSI in physics learning, so they were excluded from the main analysis.

### 2.6. Data Analysis

Data analysis in this study was carried out through several systematic stages through a combination of Scopus, Convidence, and Microsoft Excel databases. The steps of data analysis are as follows:

1. Initial data retrieval obtained through the scopus database using the keywords "socio", "scientific", "issues", "physics", and "learning" or 'education', with filter year "2020-2025", subject area "physics and astronomy", document type "article, conference paper, and review", language "english". The data that has been obtained is exported in CSV format.
2. Scopus CVS files are imported into Convidence to support the systematic review process through duplicate screening, title and abstract screening, and full text review. This process is documented in the form of PRISMA diagrams to maintain transparency of selection.
3. The results of Convidence are exported in the form of CVS and imported into Microsoft Excel to be visualized in the form of tables.
4. What are the research objectives put forward in studies that integrate SSInterpretation and presentation of the results of the descriptive analysis and visualization process in the form of a systematic narrative to show trends, developments, scientific contributions, and the direction of SSI research in the context of physics learning.

## 3. Result

### 3.1. Analysis of Article Findings on SSI in Physics Learning

The articles analyzed were obtained through a selection process based on predefined inclusion and exclusion criteria to ensure data relevance and quality. Information on the main findings of the selected articles from 2020 to 2025 are presented systematically in Table 2.

**Table 2.** *Article Findings on SSI in Physics Learning*

| Author | Findings |
|---|---|
| (Suprapto & Admoko, 2021) [20] | Integration of SSI through the context of traffic light kinematics improves students' understanding of physics concepts and higher order thinking skills. |
| (Habiby et al., 2021) [21] | SSI-based explicit-reflective approach is effective in improving students' understanding of the nature of science (NOS), especially social and cultural aspects. |
| (Reswara et al., 2024) [22] | The application of the PjBL-STEAM-SSI integrated learning model significantly improves students' science literacy in energy and simple machines. |
| (Yusup, 2021) [23] | SSI is used as a context in the development of a valid and reliable energy literacy (ELA) instrument to support understanding of global energy issues. |
| (Sciarretta & Testa, 2024) [24] | The inadequacy of students' scientific knowledge in dealing with SSI emphasizes the importance of strengthening materials and teacher training for scientifically based decision making. |
| (Faschin & Hopf, 2025) [25] | The SSI context of climate change was integrated through the creation of digital infographics, which significantly improved students' scientific communication. |
| (Faschin & Hopf, 2025) [25] | The study identifies physics teachers' beliefs towards the integration of SSI in learning, particularly climate protection issues, using the SDG and PCK theoretical approaches. |

| | |
|---|---|
| (Sulisworo & Safitri, 2022) [26] | The application of SSI in the form of everyday physical phenomena is utilized in TAP worksheets to improve students' scientific argumentation skills. |
| (Suyidno et al., 2022) [27] | The issue of wetland management as the context of SSI is used in the ABCL model to enhance the creativity and environmental awareness of physics teacher candidates. |
| (Kamila & Louise, 2021) [28] | An SSI-based storybook that connects atomic theory with socio-historical context is effective in improving high school students' conceptual understanding and critical thinking. |
| (Paul-Schultz et al., 2023) [29] | SSI-based physics curriculum links energy and electricity concepts with local environmental justice issues, enhancing students' social awareness and scientific ethics. |

## 3.2. Analysis Year of Publication

Analysis of the year of publication was conducted to identify the development of research publications that examine the application of the Socio-Scientific Issues (SSI) approach in physics learning during the period 2020 to 2025. The frequency of publications per year is presented in Table 3 to provide an overview of the trends and intensity of research in that period.

**Table 3.** *Frequency of Article Publication on SSI in Physics Learning per Year*

| Year | Frequency | Percentage (%) |
|---|---|---|
| 2021 | 5 | 45,45 |
| 2022 | 2 | 18,18 |
| 2023 | 1 | 9,09 |
| 2024 | 2 | 18,18 |
| 2025 | 1 | 9,09 |
| Total | 11 | 100,00 |

## 3.3. Analysis of Physics Topics Associated with the SSI Approach

Topic analysis aims to identify physics materials or topics that are most often studied in research that integrates the SSI approach. The following distribution of physics topics based on the number of occurrences is shown in Table 4.

**Table 4.** *Frequency of Physics Topics in Articles*

| Physics Topics | Frequency | Persentase (%) |
|---|---|---|
| Energy and its Applications | 5 | 45,45 |
| Environmental and Climate Change Issues | 2 | 18,18 |
| Kinematics | 1 | 9,09 |
| Fluids | 1 | 9,09 |
| Structure and Model of the Atom | 1 | 9,09 |
| Scientific Inquiry and Modeling | 1 | 9,09 |
| Total | 11 | 100,00 |

## 3.4. Analysis of SSI Issues Used in Physics Learning

This analysis was conducted to find out the SSI issues used in physics learning, both locally and globally. The results of the analysis of SSI issues are shown in Table 5.

**Table 5.** *Frequency of SSI Issues in Articles*

| Socio-Scientific Issues | Frequency | Percentage (%) |
|---|---|---|
| Climate Change and Environmental Protection | 4 | 36,36 |
| Applications of Physics Concepts in Daily Life | 3 | 27,27 |
| Energy and Environmental Issues | 2 | 18,18 |
| Social Issues in the Context of Industry and Transportation | 2 | 18,18 |
| Total | 11 | 100,00 |

## 3.5. Analysis of Research Objectives

The research objectives were analyzed to understand the main focus of each study related to the SSI approach in physics learning. Table 6 presents a classification of the most frequently stated objectives in the reviewed articles.

**Table 6.** *Research Objectives in Articles*

| Author | Research Objectives |
|---|---|
| (Suprapto & Admoko, 2021) [20] | Introducing an SSI-based HOTS reasoning model through the context of traffic kinematics to improve concept understanding. |

| | |
|---|---|
| (Habiby et al., 2021) [21] | Developing students' understanding of Nature of Science (NOS) through SSI-based explicit-reflective approach. |
| (Reswara et al., 2024) [22] | Develop and test the effectiveness of PjBL, STEAM, and SSI integrated learning models to improve science literacy. |
| (Yusup, 2021) [23] | Developing and validating SSI-based energy literacy instruments using Rasch model for physics teacher candidates. |
| (Sciarretta & Testa, 2024) [24] | Investigating the relationship between scientific inquiry and SSR and developing TLS to improve students' reasoning ability. |
| (Faschin & Hopf, 2025) [25] | Investigating the improvement of students' verbal and visual communication through the use of infographics in climate change learning. |
| (Faschin & Hopf, 2025) [25] | Analyze physics teachers' beliefs on climate protection discussions and identify basis for teacher training. |
| (Sulisworo & Safitri, 2022) [26] | Developing TAP-based online worksheets to improve students' argumentation skills in physics learning. |
| (Suyidno et al., 2022) [27] | Analyzing the effectiveness of ABCL learning in improving creativity and environmental awareness of physics teacher candidates. |
| (Kamila & Louise, 2021) [28] | Developing 4S TMD-based atomic theory storybooks to improve students' understanding and critical thinking. |
| (Paul-Schultz et al., 2023) [29] | Adapted energy and electricity instruction to allow students to relate physics to local environmental justice issues. |

### 3.6. Education Level Analysis

Education level analysis was conducted to find out at which education level the SSI approach is most widely applied in physics learning. Table 7 shows the distribution of education levels based on the frequency of articles.

**Table 7.** *Level of Education in Articles*

| Level of Education | Frequency | Percentage (%) |
|---|---|---|
| HIGH SCHOOL | 4 | 36,36 |
| MIDDLE SCHOOL | 3 | 27,27 |
| Colleges | 3 | 27,27 |
| Teacher | 1 | 9,09 |
| Total | 11 | 100,00 |

### 3.7. Analysis of the Dependent Variables Used

The analysis of dependent variables aims to identify the most studied dependent variables in the study of the application of SSI in physics learning. The following Table 8 lists the variables found along with the highest number of occurrences.

**Table 8.** *The Dependent Variable in the Articles*

| Dependent Variable | Frequency | Percentage (%) |
|---|---|---|
| Student Comprehension | 4 | 36,36 |
| Science and Energy Literacy | 2 | 18,18 |
| Scientific Communication and Argumentation Skills | 2 | 18,18 |
| Attitude and Affection | 2 | 18,18 |
| Scientific Thinking Skills | 1 | 9,09 |
| Total | 11 | 100,00 |

## 4. Discussion

### 4.1. Analysis of Article Findings on SSI in Physics Learning

This study found that the Socio Scientific Issue (SSI) approach has been widely applied in various forms of learning strategies to improve the quality of learning at various levels of education. Most of the articles showed that the use of real social and scientific contexts such as traffic, climate change, and energy justice, improved students' understanding of physics concepts and higher order thinking skills such as studies conducted by Azizah et al., 2021; Paul-Schultz et al., 2023; Reswara et al., 2024; Suprapto & Admoko, 2021 discussing the use of kinematics topics in traffic lights that not only encourage students in understanding motion, but also help in improving analysis skills and skills in science-based decision making [30][29][22][20]. In addition, studies that discuss the explicit-reflective approach that integrates the SSI context successfully deepen students'

understanding of the Nature of Science (NOS), especially the social and cultural aspects of science such as the research conducted by Habiby et al., 2021 [21].

Some studies such as those conducted by Kamila & Louise, 2021; Sulisworo & Safitri, 2022; Yusup, 2021 also examine the development of SSI-based learning tools, such as worksheets, science storybooks, and validated energy literacy instruments that are proven to be able to improve science literacy, argumentation skills, and active participation of students in solving contextual problems [28][26][23]. The integration of SSI also supports the development of affective aspects such as environmental awareness and ethical awareness, especially when global issues such as climate change are raised [31]. In addition, a study conducted by Faschin & Hopf, 2025 [25] stated that research on teachers shows the need for training so that they are ready to integrate social issues in physics learning.

### 4.2. Year of Publication Analysis

Analysis of publication trends shows that the study of the Socio-Scientific Issues (SSI) approach in physics learning has fluctuated during the period 2020 to 2025. 2021 was recorded as the year with the highest number of publications, namely five articles or 45.45% of the total. This trend shows that in that year, the SSI approach became the main spotlight in the physics education research agenda, possibly as a response to the demands of meaningful and contextualized learning after the COVID-19 pandemic [17]. The decline in the number of publications in subsequent years does not necessarily reflect a decline in interest, but may indicate a shift in focus towards implementation or practical development in the field such as studies conducted by Azizah et al., 2021; Reswara et al., 2024; Sulisworo & Safitri, 2022; Suyidno et al., 2022; Yusup, 2021 [30][22][26][27][23]. This trend is also in line with the results of other literature studies that show that interest in issue-based contextual education has increased in the last decade such as studies conducted by Azizah et al., 2021; Faschin & Hopf, 2025; Habiby et al., 2021; Suprapto & Admoko, 2021 [30][25][21][20].

### 4.3. Analysis of Physics Topics Associateda with the SSI Approach

The physics topic most associated with the SSI approach in the analyzed studies is "Energy and its Applications", with a frequency of 45.45% as found in studies conducted by Faschin & Hopf, 2025; Paul-Schultz et al., 2023; Reswara et al., 2024; Suyidno et al., 2022; Yusup, 2021 [25][29][22][27][23]. While the studies conducted by Faschin & Hopf, 2025; Paul-Schultz et al., 2023; Reswara et al., 2024; Suyidno et al., 2022; Yusup, 2021 [25][29][22][27][23] show the dominance that energy material has a strong connection with social and global science issues, such as the energy crisis, the use of renewable energy, and environmental conservation. This strengthens the position of energy topics as a bridge between physics concepts and real-life issues. In addition to energy, topics such as climate change through fluid and thermodynamics by Azizah et al., 2021; Faschin & Hopf, 2025; Sulisworo & Safitri, 2022 [30][25][26], kinematics, as well as atomic structure, studies by Kamila & Louise, 2021; Suprapto & Admoko, 2021 [28][20], with a lower frequency of these studies. This diversity of topics indicates an effort to expand the range of SSI approaches in various physics concepts. However, there are still gaps in the utilization of other topics such as waves, dynamic electricity, or modern physics that have not been widely contextualized in SSI research [12]. Thus, these topics are opportunities for further exploration in future studies.

### 4.4. Analysis of SSI Issues Used in Physics Learning

The types of Socio-Scientific Issues (SSI) used in physics learning in the articles analyzed show a strong tendency towards environmental issues, with "Climate Change and Environmental Protection" being the most dominant context (36.36%). The use of this issue reflects the increasing urgency of education towards environmental sustainability and global ecological awareness. In addition, some studies such as those conducted by Paul-Schultz et al., 2023; Reswara et al., 2024; Suprapto & Admoko, 2021 [29][22][20] also utilized everyday issues such as traffic and domestic energy as much as (27.27%), as well as social issues by Sciarretta & Testa, 2024; Suprapto & Admoko, 2021 [24][20] related to industry and transportation (18.18%). This variety of contexts indicates that the SSI approach in physics is able to bridge between academic content and social realities faced by students. Interestingly, most of the issues used have local and global values simultaneously, reinforcing the relevance of physics education in shaping citizens who are aware of the social impact of science such as the study conducted by Paul-Schultz et al., 2023 [29]. This is in line with the spirit of 21st century education that places science literacy as the basis for decision-making in everyday life [32].

### 4.5. Analysis of Research Objectives

The research objectives analyzed in the studies on the SSI approach in physics learning show a variety of objectives, both in terms of developing learning tools such as studies conducted by Kamila & Louise, 2021; Sulisworo & Safitri, 2022; Yusup, 2021 [28][26][23], improving learning outcomes such as studies Reswara et al., 2024; Sulisworo & Safitri, 2022; Suprapto & Admoko, 2021 [22][26][20], and research objectives regarding teacher empowerment as conducted by Faschin & Hopf, 2025 [25]. In general, most of the studies aim to improve the quality of learning by integrating social context into physics learning such as the studies conducted by Paul-Schultz et al., 2023; Reswara et al., 2024; Suprapto & Admoko, 2021 [29][22][20]. On the other hand, the study conducted by Yusup, 2021 [23] focused on the development and validation of SSI-based tools and

instruments, such as worksheets, sians storybooks, and Rasch model-based energy literacy instruments. Other research focuses more on strengthening the cognitive and metacognitive dimensions of students such as the study conducted by Habiby et al., 2021 [21] which aims to improve concept understanding, higher order thinking skills (HOTS), and mastery of the nature of science (NOS), especially in terms of social and cultural aspects of science. This analysis shows that the SSI approach in learning is not only a learning strategy, but also a transformative tool that integrates cognitive, affective aspects, and also social values in science education [6].

### 4.6. Education Level Analysis

The analysis shows that the SSI approach is most widely applied at the high school level as much as 36.36% such as studies conducted by Kamila & Louise, 2021; Paul-Schultz et al., 2023; Sciarretta & Testa, 2024; Sulisworo & Safitri, 2022 [28][29][24][26], followed by junior high school and also college which each amounted to 27.27% studied by Azizah et al., 2021; Habiby et al., 2021; Reswara et al., 2024 [30][21][22] and one study at the teacher level such as a study conducted by Faschin & Hopf, 2025 [25]. The dominance of the high school level indicates that at this level of education, it is considered more ready to actively engage in issues that demand critical and reflective thinking skills [33].

### 4.7. Analysis of Dependent Variables Used

The most widely used dependent variable in SSI research on physics learning is student understanding at 36.36% such as studies conducted by Habiby et al., 2021; Kamila & Louise, 2021; Paul-Schultz et al., 2023; Suprapto & Admoko, 2021 [21][28][29][20]. In addition, science and energy literacy, communication skills on scientific argumentation, and affective attitudes are also one of the important concerns in several studies such as those conducted by Azizah et al., 2021; Faschin & Hopf, 2025; Reswara et al., 2024; Sulisworo & Safitri, 2022; Suyidno et al., 2022; Yusup, 2021 [30][25][22][26][27][23], only a few studies have explored scientific thinking skills specifically as conducted by Sciarretta & Testa, 2024 [24]. However, based on this analysis, there are still opportunities to explore other variables such as evidence-based decision making or students' real actions towards social issues.

## 5. Conclusion

This study identifies trends from content analysis of Sociological and Scientific Issues (SSI) research in physics education. Content analysis shows that the SSI approach in physics education has been proven to improve conceptual understanding, critical thinking, and science literacy. In addition, the topic of "energy and its applications" is the most dominant topic in this study. SSI also shows the role of meaningful 21st-century learning, which not only shapes cognition but also contributes to the development of students' affective and social values. High school level is the main target because it is considered to be the most cognitively and reflectively ready. The variable most frequently explored in this study is student understanding, but the potential to explore variables such as evidence-based decision-making and student action on social issues is still wide open. Evidence-based decision-making and student action on social issues help students understand the complexity of problems comprehensively, hone critical and analytical thinking skills, build arguments from various stakeholder perspectives, and foster active participation, social responsibility, and reflection in decision-making [34]. In the future, the findings of this study can be used as a reference to support further research and innovation in the field of physics learning approaches. Future systematic literature reviews (SLRs) are recommended to explore variables that have not been widely explored, such as evidence-based decision-making and student social actions, expand the scope beyond the high school level, cover a wider range of physics topics, and utilize diverse databases to obtain a more comprehensive picture of SSI research in physics learning.

## References


[1] S. Ban and S. N. D. Mahmud, "Research and Trends in Socio-Scientific Issues Education: A Content Analysis of Journal Publications from 2004 to 2022," *Sustain. Switz.*, vol. 15, no. 15, 2023, doi: 10.3390/su151511841.

[2] D. Zeidler, "Socioscientific Issues," in *Encyclopedia of Science Education*, Springer Netherlands, 2015, pp. 998–1003. doi: 10.1007/978-94-007-2150-0_314.

[3] C. Viehmann, J. M. Fernández Cárdenas, and C. G. Reynaga Peña, "The Use of Socioscientific Issues in Science Lessons: A Scoping Review," *Sustain. Switz.*, vol. 16, no. 14, 2024, doi: 10.3390/su16145827.

[4] Y. Hwang, Y. Ko, S. S. Shim, S. Y. Ok, and H. Lee, "Promoting engineering students' social responsibility and willingness to act on socioscientific issues," *Int. J. STEM Educ.*, vol. 10, no. 1, 2023, doi: 10.1186/s40594-023-00402-1.

[5] A. Z. Macalalag, A. Kaufmann, B. Van Meter, A. Ricketts, E. Liao, and G. Ialacci, "Socioscientific issues: promoting science teachers' pedagogy on social justice," *Discip. Interdiscip. Sci. Educ. Res.*, vol. 6, no. 1, 2024, doi: 10.1186/s43031-024-00118-4.

[6] P. Högström, N. Gericke, J. Wallin, and E. Bergman, "Teaching Socioscientific Issues: A Systematic Review," *Sci. Educ.*, 2024, doi: 10.1007/s11191-024-00542-y.
[7] M. R. Ariza *et al.*, "Socio-scientific inquiry-based learning as a means toward environmental citizenship," *Sustainability*, vol. 13, no. 20, 2021, doi: 10.3390/su132011509.
[8] D. Retno Sari and S. Saputro, "A Systematic Review on Integrating SSI into Science Education: Its Impact on 21st Century Skills (2014-2024)," *Educ. Stud. Res. J. ESRJ*, vol. 2, no. 1, p., 2025.
[9] N. Hikmah, I. H. Siregar, F. Mufit, L. Lufri, and A. Andromeda, "The Effect of STEM Integration in Science and Physics Learning on Students' Scientific Attitudes: A Meta-Analysis," *Form. J. Ilm. Pendidik. MIPA*, vol. 15, no. 1, 2025, doi: 10.30998/formatif.v15i1.27275.
[10] Febriani, J. Jumadi, and W. S. B. Dwandaru, "Socio-scientific issues in physics learning to improve students' critical thinking skills," *Rev. Mex. Física E*, vol. 20, no. 1 Jan-Jun, 2023, doi: 10.31349/revmexfise.20.010202.
[11] S. Kassiavera, A. Suparmi, C. Cari, and Sukarmin, "Analysis of students' answer about the conservation of mechanical energy concept in physics education Bengkulu University," *Humanit. Soc. Sci. Rev.*, vol. 8, no. 3, pp. 755–763, 2020, doi: 10.18510/hssr.2020.8381.
[12] A. Arika, S. Suliyanah, S. Admoko, N. Suprapto, and U. A. Deta, "Bibliometric Analysis of Socio Scientific Issues (SSI) in Physics (2019–2020)," in *Proceedings of the International Joint Conference on Science and Engineering (IJCSE 2021), Advances in Engineering Research, vol. 209*, Atlantis Press, 2021, pp. 363–369. doi: 10.2991/aer.k.211215.063.
[13] U. A. Deta *et al.*, "Research Trend of Socio Scientific Issues (SSI) in Physics Learning Through Bibliometric Analysis in 2011-2020 using Scopus Database and the Contribution of Indonesia," *J. Penelit. Pendidik. IPA*, vol. 7, no. 4, pp. 682–692, 2021, doi: 10.29303/jppipa.v7i4.862.
[14] S. Bezen, "Comparative Evaluation of Socioscientific Issues in Secondary Physics Curriculum and Textbooks," *E-Kafkas Eğitim Araştırmaları Derg.*, vol. 11, no. 4, pp. 510–523, 2024, doi: 10.30900/kafkasegt.1469478.
[15] A. Valen and S. Jumini, "Application Socio Scientific Issues (SSI) Approach to Improve Students' Physics Concept Understanding Ability," *Nukleo Sains J. Pendidik. IPA*, vol. 3, no. 2, pp. 67–76, 2024, doi: 10.33752/ns.v3i2.6370.
[16] A. I. Mustapha and I. Ebomoyi, "Methodological Usefulness of Content Analysis in Social Science Research," *Afr. Res. Rev.*, vol. 13, no. 1, pp. 93-?, 2019.
[17] J. Hernández-Ramos, J. Pernaa, L. Cáceres-Jensen, and J. Rodríguez-Becerra, "The effects of using socio-scientific issues and technology in problem-based learning: A systematic review," *Educ. Sci.*, vol. 11, no. 10, 2021, doi: 10.3390/educsci11100640.
[18] A. Naveed, A. Zhuparova, N. Ahmad, and R. FathollahZadeh Aghdam, "Sources of information on sustainable innovation: a citation-based systematic literature review and content analysis," *Total Qual. Manag. Bus. Excell.*, vol. 34, no. 9–10, pp. 1126–1151, 2023, doi: 10.1080/14783363.2022.2157713.
[19] A. Rogge, L. Anter, D. Kunze, K. Pomsel, and G. Willenbrock, "Standardized Sampling for Systematic Literature Reviews (STAMP Method): Ensuring Reproducibility and Replicability," *Media Commun.*, vol. 12, p., 2024.
[20] N. Suprapto and S. Admoko, "Kinematics of 'traffic Light': A Socio Scientific Issue Performed by Undergraduate Physics Students," *J. Phys. Conf. Ser.*, vol. 1899, no. 1, 2021, doi: 10.1088/1742-6596/1899/1/012149.
[21] I. Habiby, Hernani, and Riandi, "Improving students' NOS understanding through explicit-reflective learning with socio-scientific issues context," *J. Phys. Conf. Ser.*, vol. 1806, no. 1, 2021, doi: 10.1088/1742-6596/1806/1/012122.
[22] T. R. Reswara, Parno, D. Nugraheni, P. Suwasono, R. Jannah, and N. Khamis, "Increasing scientific literacy abilities through SSI integrated PjBL-STEAM learning model on energy and simple machine topics," *J. Phys. Conf. Ser.*, vol. 2866, no. 1, 2024, doi: 10.1088/1742-6596/2866/1/012107.
[23] M. Yusup, "Using Rasch model for the development and validation of energy literacy assessment instrument for prospective physics teachers," *J. Phys. Conf. Ser.*, vol. 1876, no. 1, 2021, doi: 10.1088/1742-6596/1876/1/012056.
[24] W. Sciarretta and I. Testa, "Investigating the relationships between students' reasoning in Socio-Scientific Issues and knowledge about scientific inquiry and modelling," *J. Phys. Conf. Ser.*, vol. 2727, no. 1, 2024, doi: 10.1088/1742-6596/2727/1/012020.
[25] M. Faschin and M. Hopf, "Discussing climate protection measures in physics classroom - Expert ranking on the importance of possible teaching beliefs," *J. Phys. Conf. Ser.*, vol. 2950, no. 1, 2025, doi: 10.1088/1742-6596/2950/1/012037.

[26] D. Sulisworo and I. Safitri, "Online Student-worksheet Based on Toulmin Argumentation Pattern in Physics Learning," *J. Phys. Conf. Ser.*, vol. 2394, no. 1, 2022, doi: 10.1088/1742-6596/2394/1/012033.
[27] S. Suyidno, S. Haryandi, S. Mahtari, A. Azhari, and T. Sunarti, "Autonomy-Based Creative Learning: Equip Creativity and Concern for Prospective Physics Teachers in Wetland Environments," *J. Phys. Conf. Ser.*, vol. 2392, no. 1, 2022, doi: 10.1088/1742-6596/2392/1/012027.
[28] S. W. Kamila and I. S. Y. Louise, "Development of story of atom enrichment book apply four steps teaching material development (4S TMD)," *J. Phys. Conf. Ser.*, vol. 1806, no. 1, 2021, doi: 10.1088/1742-6596/1806/1/012202.
[29] N. Paul-Schultz, K. E. Gray, and R. E. Scherr, "Connecting Energy and Electricity Instruction to Local Environmental Justice Issues," *Phys. Teach.*, vol. 61, no. 6, pp. 519–521, 2023, doi: 10.1119/5.0127461.
[30] D. N. Azizah, N. Y. Rustaman, and L. Rusyati, "Enhancing students' communication skill by creating infographics using Genially in learning climate change," *J. Phys. Conf. Ser.*, vol. 1806, no. 1, 2021, doi: 10.1088/1742-6596/1806/1/012129.
[31] A. S. Utami, I. Kaniawati, and S. Sriyati, *Citizen Science: Fostering Creative Thinking in Environmental Education*. in Vol. 1. Atlantis Press SARL, 2023. doi: 10.2991/978-2-38476-052-7_29.
[32] M. U. Genisa, B. Subali, A. Djukri Agussalim, and H. Habibi, "Socio-scientific issues implementation as science learning material," *Int. J. Eval. Res. Educ.*, vol. 9, no. 2, pp. 311–317, 2020, doi: 10.11591/ijere.v9i2.20530.
[33] B. Sani, "Perbandingan Kemampuan Siswa Berpikir Reflektif dengan Siswa Berpikir Intuitif di Sekolah Menengah Atas," *J. Pendidik. Mat. Dan Sains*, vol. 4, no. 2, pp. 63–76, 2016, doi: 10.21831/jpms.v4i2.12947.
[34] M. Sakamoto, E. Yamaguchi, T. Yamamoto, and K. Wakabayashi, "An intervention study on students' decision-making towards consensus building on socio-scientific issues," *Int. J. Sci. Educ.*, vol. 43, no. 12, pp. 1965–1983, 2021, doi: 10.1080/09500693.2021.1947541.