25 (2), 2024, 972-985

Jurnal Pendidikan MIPA

e-ISSN: 2685-5488 | p-ISSN: 1411-2531

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Socio Scientific Issue (SS1) Approach as a Momentum to Instill Cultural Literacy and Scientific Literacy Through Natural Science Learning

I Komang Wisnu Budi Wijaya[1*], Ni Made Ayu Suryaningsih[2], Kadek Ayu Astiti[3], Christiani Endah Poerwati[2] & Andika Syahputra[4]

[1]Department of Elementary School Teacher Education, Universitas Hindu Negeri I Gusti Bagus Sugriwa Denpasar, Indonesia

[2]Study Program of Early Childhood Education Teacher Education, Universitas Dhyana Pura, Indonesia

[3]Study Program of Science Education, Universitas Pendidikan Ganesha, Indonesia

[4]SMAN Titian Teras, Indonesia

Abstract: Education is a process of cultural inheritance. Moreover, culture and science are also interconnected. However, the fact is that cultural and scientific literacy among students in Indonesia is still low. Therefore, improvements are needed in the learning process. One of the recommended learning approaches is learning with the SSI approach. This research aims to analyze how to instill cultural literacy and scientific literacy within the SSI approach. This research is classified as a literature review. Data is sourced from various literature such as journals, proceedings, theses, and other scientific sources. The collected data is then selected, reviewed, and analyzed, and subsequently synthesized in the discussion. The results of the discussion are summarized to form a conclusion. The research results state that the SSI approach can instill cultural literacy through the process of internalization, so that at every stage of the SSI approach, aspects of cultural literacy can be instilled, starting from the introduction of culture, cultural complexity, and cultural care. In addition, aspects of science literacy are also developed simultaneously, starting from the introduction of science in context, knowledge and processes of science, and the development of scientific attitudes. In applying the SSI approach to science education, teachers should be able to design lessons that integrate cultural and sociocultural aspects into science learning, as well as facilitate learning and assess the success of the education.

Keywords: SSI approach, cultural literacy, scientific literacy.

▪ INTRODUCTION

The Indonesian nation has a diversity of cultures. That diverse culture generally includes customs, language, traditions, and many other aspects (Iskandar, 2016). The cultural diversity will shape the national culture, which will also become a symbol of national identity. The culture of the Indonesian nation is formed from various ethnic groups, races, and residential areas. Cultural diversity should certainly be preserved so that the Indonesian nation does not lose its identity.

One of the ethnic groups with a unique and distinctive culture is the Balinese. Bali, as one of the world's tourist destinations, has an appeal due to its culture and local wisdom. Bali has many local wisdoms that have valid and reliable truths passed down through generations. The local wisdom of the Balinese people is spread across various fields, ranging from agriculture, education, architecture, and other areas. Local wisdom must certainly be preserved and socialized to future generations to maintain its consistency (Indrawan et al., 2020).

However, the fact is that Balinese culture and local wisdom are threatened with extinction. This is because the Balinese society has currently shifted towards a hedonistic and liberal society (Mahardika & Darmawan, 2016). The Balinese society, which once

I Komang Wisnu Budi Wijaya
*Email: wisnu.budiwijaya240191@gmail.com

DOI: http://dx.doi.org/10.23960/jpmipa/v25i2.pp972-985
Received: 30 October 2024
Accepted: 15 November 2024
Published: 19 November 2024

prioritized social communities and local wisdom, has now shifted towards a more individualistic society, influenced by Western culture, and is slowly forgetting the local wisdom that has existed since ancient times (Tristaningrat, 2018). Moreover, the younger generation in Bali, especially students, also have low cultural literacy. The low cultural literacy is caused by a very low interest in studying Balinese culture and a tendency to be more attracted to Western influences. Local wisdom that has also shaped the identity of the Balinese tribe or community must be preserved to prevent extinction.

Education is one form of the process of cultural inheritance and local wisdom that has already formed in society (Alwi et al., 2021). One way to pass on Balinese culture and local wisdom into the education process is by integrating learning resources, curriculum, and other teaching instruments (Indrawan et al., 2020).. Through this process, students will simultaneously get to know and learn about Balinese culture and local wisdom, fostering an interest in preserving it. Furthermore, the hope is that by integrating Balinese culture and local wisdom into the learning process, it will shape students who possess cultural literacy. Cultural literacy is the ability to understand and respond to culture as a national identity (Pujiatna, 2021). Balinese cultural literacy that can be instilled in the educational process includes symbols, language, norms, rituals, changing norms and beliefs, values, and artifacts (Adijaya, 2023).

Besides the issues regarding cultural literacy, students' scientific literacy in Indonesia is also still unsatisfactory. The measurement of science literacy conducted by the Organization for Economic Co-operation and Development (OECD) through the PISA (Programme for International Student Assessment) in 2018 reported that Indonesia ranked 70th out of 78 surveyed countries (Fuadi et al., 2020). This is certainly very concerning because students interact with scientific phenomena every day, and currently, science has become one of the benchmarks of a country's prestige on the international stage. One of the causes of low science literacy is the tendency of science education to be conventional, and teachers in science education only focus on mastering the material and rarely touch on other aspects of science literacy (Yusmar & Fadilah, 2023).

The gap in science education related to cultural literacy and science literacy in Indonesia reflects complex and multidimensional challenges. Science literacy, defined as the ability to understand, use, and apply scientific knowledge in everyday life contexts, is becoming increasingly important in the era of globalization and rapid technological development (Nurpratiwi et al., 2023). However, data shows that students' science literacy skills in Indonesia are still relatively low, with PISA survey results indicating a declining ranking year after year (Utami & Setyaningsih, 2022). This indicates a significant gap in science education, which needs to be addressed through a more integrative and contextual approach.

One of the factors contributing to this gap is the lack of integration between cultural literacy and scientific literacy in the education curriculum. Research shows that an ethnopedagogical approach in science education can help students develop scientific literacy while also understanding their cultural identity (Rahmawati et al., 2020). By linking science material with local cultural contexts, students not only learn about science but also develop a sense of patriotism and responsibility towards preserving their culture (Rahayu et al., 2022). This approach demonstrates that cultural literacy can serve as a bridge to enhance scientific literacy, thereby creating a more relevant and meaningful learning experience for students.

Changes in the learning process are urgent to implement in order to instil cultural literacy and scientific literacy. Moreover, many cultures in Indonesia, especially in Bali, contain scientific concepts that are relevant and have been proven to be valid and reliable over a long period (Khusniati, 2014). One of the recommended learning approaches to instil cultural literacy and scientific literacy is the socio-scientific issue (SSI) based learning approach. SSI learning is science education that raises issues developing in the surrounding community and can be studied scientifically (Winarni et al., 2022). According to Ratchliffe (2003), the issues that can be raised in SSI learning have the following requirements: 1) based on science; 2) opinion formation; 3) directed towards local, national, or global dimensions; and 4) requiring an understanding of events occurring in the surrounding environment (Siska et al., 2020). This approach also provides students with the opportunity to evaluate information, analyze impacts, and make decisions based on socio-scientific issues they face. For example, the application of SSI in science education in Bali can use the topic of the Subak system to explain scientific phenomena such as soil erosion. By studying Subak, students not only understand the scientific aspects of soil conservation but also the importance of the system in maintaining social and cultural sustainability (Windia et al., 2018).

Various studies support that an approach introducing cultural context in science education can enhance student engagement and scientific understanding. For example, Khusniati's (2014) study shows that the use of a science learning model based on local wisdom successfully enhances students' appreciation of culture while deepening their understanding of scientific concepts. Another study by Rahayu (2019) found that the SSI approach, which emphasizes relevant socio-scientific issues, can enhance students' critical thinking skills in understanding the relationship between science, society, and the environment. Additionally, research conducted by Li & Guo (2021) in Asian countries also supports that the SSI approach helps students develop a better understanding of scientific phenomena by incorporating cultural elements and social issues into learning.

The Socio-Scientific Issues (SSI) approach is implemented in various countries to enhance students' critical thinking, argumentation, and decision-making skills through issues that connect science and society. SSI encourages students to engage in discussions about complex social issues, such as climate change and biotechnology. (Hancock et al., 2019; Nida et al., 2020). In Indonesia, although the importance of SSI has been recognized, its implementation is still limited. Research shows that SSI-based learning can enhance students' scientific argumentation skills (Siska et al., 2020). In other countries like Turkey, although SSI has been integrated into the curriculum, challenges in implementation still exist, especially in terms of teacher training (Genç & Genç, 2017). This approach allows students to understand the relationship between science and social issues, including cultural aspects, that are relevant to their lives (Zeidler & Nichols, 2009). This approach is also effective in higher education, where students develop critical thinking and ethical skills (Chowning et al., 2012; Hernández-Ramos et al., 2021). Overall, SSI has the potential to enhance science education, but there are challenges that need to be addressed.

Moving on to that matter, the researcher is interested in conducting a literature study to analyse strategies for instilling scientific literacy and cultural literacy in science learning through the SSI approach. This research is expected to contribute to science education in Indonesia by instilling a deeper cultural perspective in science learning, as

well as shaping a generation that is more sensitive to social and environmental issues relevant to the multicultural life in Indonesia.

▪ METHOD

The writing of this scientific article uses qualitative research methods and literature study or library research by examining various sources, both books and articles from various research journals, resulting in a high-quality scientific article. The stages carried out in this research include literature search, synthesis process, and conclusion drawing. Effective study search and selection of articles to be analysed, in accordance with the established research objectives (Masri & Gistituati, 2023). The literature collection was conducted over two months, namely August and September 2024. All the journals used are the result of screening based on the following criteria: 1) Reputable international journals, 2) Accredited national journals, 3) Articles published within the last 10 years,

Having themes related to socio-scientific issues, cultural literacy, and scientific literacy. The data processing technique used is categorizing the titles based on the specified themes, namely socio-scientific issues, cultural literacy, and scientific literacy. The data obtained in this research is secondary data because it does not come from direct observation but rather from literature and the results of other people's research (Halimah, 2023).

Writing this scientific article uses qualitative research methods and literature studies or library research by reviewing various sources, both books and articles from various research journals, to produce quality scientific articles. The literature research design used is a systematic review, where this method is used to identify, evaluate and interpret research results that are relevant to the research problems raised (Siswanto, 2010). The sequence of the systematic review research process according to Perry & Hammond (2002) starts from 1) identifying research questions, 2) developing research protocols, 3) determining the location of the research results database as the search area, 4) selecting relevant research results, 5) selecting research results quality, 6) data extraction from individual studies, 7) synthesis of results, 8) Presentation of results. In general, the stages carried out in this research start from literature search, synthesis process and drawing conclusions. Effective study search and selection of articles to be analyzed, in accordance with the stated research objectives (Masri & Gistituati, 2023). Literature collection was carried out over two months, namely August and September 2024. The literature used was obtained through searches from various sources such as Google Scholar, Scopus and PubMed. The search was carried out by entering keywords related to the problem being studied, namely socio scientific issues, cultural literacy and scientific literacy.

All journals used are the result of screening using the following criteria: 1) Reputable international journals, 2) Accredited national journals, 3) Articles published within the last 10 years, 4) Have themes related to socio-scientific issues, cultural literacy and scientific literacy. After collecting potential literature in accordance with the formulation of this research problem, the researcher then carried out a study selection to select the literature to be reviewed. The data processing technique used is to categorize titles based on specified themes, namely socio scientific issues, cultural literacy and scientific literacy. The data obtained in this research is secondary data because it does not come from direct observation but is based on literature and other people's research results (Halimah, 2023).

The data synthesis process was carried out using narrative synthesis techniques to summarize the findings from various studies. If there are differences or contradictions between the study results, the researcher triangulates the sources so that accurate data is obtained and the differences found can be handled so as to produce a conclusion that contributes to the research results. The validity and reliability of the results of literature analysis were carried out by triangulating sources related to socio-scientific issues in increasing cultural literacy and scientific literacy. Source triangulation is carried out by looking for other references related to the topic and then analyzing the suitability of the meaning to produce a valid interpretation.

▪ RESULT AND DISSCUSSION

Cultural Literacy

When talking about cultural literacy, we will encounter various definitions. Cultural literacy can be defined as an individual's ability to understand and have a positive attitude towards a culture as an identity (Kemdikbud, 2017; Pujiono & Sahayu, 2021). Cultural literacy can also be interpreted as an understanding, appreciation, and involvement of an individual in the culture surrounding them (Iskandar, Dewi, & Hayat, 2024). Then, another opinion states that cultural literacy is the ability to understand culture, anticipate the influence of foreign cultures on existing cultures, and create creativity for cultural development (Tohani et al., 2019). Based on this definition, it can be concluded that cultural literacy is actually the individual's ability to understand, have a positive attitude, and engage in recognizing and preserving existing cultures.

Cultural literacy is an important trait for the younger generation to possess in the 21st century. This is because, in this information age, information flows rapidly, making it easy for foreign cultural influences to permeate the younger generation, gradually leading to the neglect of the existing local culture (Saftri & Ramadan, 2022). Therefore, cultural literacy has become an urgent matter to be developed. Cultural literacy will make Indonesian culture, which has already become the identity of the nation, sustainable in the midst of the global community (Widiastuti et al., 2024)

Individuals who are culturally literate can be identified by several indicators, namely understanding cultural complexity, recognizing their own culture, and being concerned about culture (Lestari et al., 2022). Cultural literacy must be instilled in students or the younger generation. Individuals who are culturally literate are able to appreciate diversity, build bridges between cultures, enrich experiences, promote tolerance, and open dialogues between cultures (Maine et al., 2019; Rendiyawati et al., 2024).

Science Literacy

Science literacy is an individual's ability to apply scientific concepts in identifying, making decisions, and drawing conclusions related to science, technology, environment, and society (Situmorang, 2016). According to PISA, scientific literacy is the ability to use science as a discipline to solve problems and explain scientific phenomena, understand the main characteristics of knowledge built by humans through the inquiry process, awareness that science and technology contribute to shaping the environment, and the willingness to engage in issues related to science (OECD, 2013; Wulandari & Sholihin, 2016). Science literacy is important for students because it enables them to understand

and apply science in their daily lives and to be wise towards the environment (Sutrisna, 2021). Currently, science literacy is one of the goals of science education in all countries (Istyadji & Sauqina, 2023)..

Science literacy as formulated by the OECD consists of four dimensions: context, knowledge, competence, and attitude (Asyhari & Hartati, 2015). The context of science involves situations in everyday life that encompass the understanding and application of scientific concepts. The science applications referred to include life and health, earth and environment, and technology (Nofiana & Julianto, 2017). Then the aspect of competence is a person's ability to solve scientific problems using scientific methods, which includes the ability to identify scientific issues, explain scientific phenomena, and use scientific evidence. (Rini et al., 2021). Then, the aspect of knowledge in science literacy encompasses the extent of an individual's understanding of science, including conceptual, procedural, factual, and metacognitive aspects (Yasa et al., 2022). The aspect of attitude in science literacy according to OECD includes responsibility towards resources and the environment, interest in scientific issues, and support for scientific inquiry (Hartati, 2016).

Science literacy has levels or stages of development. These levels consist of four strata: nominal level, functional level, conceptual level, and multidimensional level. The nominal level is where one is able to understand scientific concepts but is still prone to misconceptions. The functional level is where an individual's science literacy is based on literature and explains scientific phenomena in only certain aspects. The conceptual level is the ability of science literacy where an individual understands scientific concepts well, relates them to other scientific concepts, and possesses inquiry skills. Lastly, the multidimensional level refers to a person's ability to connect scientific concepts with other fields of knowledge such as the environment, social sciences, and culture (Shofiyah, 2015).

Socio Scientific Issue (SSI) Approach

The SSI approach is a method in science education that invites students to identify science-related problems connected to social issues or local wisdom that have complex solutions (Shoba et al., 2023). SSI is applied by referring to various social issues related to science, whether conceptual, factual, or procedural, but they are inherently dilemmas, such as those related to environmental damage, climate change, and so on (Andryani et al., 2016). In learning with the SSI approach, students are given the opportunity to evaluate, analyze the impact, and make decisions regarding SSI (Salim & Prasetyo, 2018). In addition, in the SSI approach, students will also be able to conduct scientific activities while realizing that science, society, and the environment are interconnected (Sa'adah et al., 2022).

The application of SSI in learning activities consists of four stages: 1) scientific background, which presents issues from the perspective of scientific knowledge; 2) evaluation of information, which involves evaluating the presented socio-scientific issues; 3) examining local, national, and global impacts; and 4) decision making, which involves making decisions on the presented social issues (Yuliastini et al., 2016). In learning with the SSI approach, in addition to understanding science, it is also expected to develop students' social attitudes and concern for the environment and culture (Siska et al., 2019).

In determining the issues or problems raised in the SSI approach, at least several requirements must be met, namely: 1) authentic, meaning it is currently being widely discussed by the community; 2) relevant to students' lives now and in the future; 3) evaluable from various perspectives; 4) providing space for open discussion; and 5) related to science. (Stolz et al., 2013). Additionally, in the implementation of the SSI approach in science learning, it is important to ensure that students are actively involved in the learning process, the learning environment is cooperative and collaborative, there is mutual respect between teachers and students, and students feel comfortable while learning (S. Rahayu, 2019).

Developing Cultural Literacy and Scientific Literacy in the SSI Approach

Cultural literacy can be developed in the learning process. The development of cultural literacy is a form of cultural inheritance through the process of education. The process of cultural inheritance occurs through three stages: internalization, socialization, and enculturation (Fauzi, 2021; Latuheru & Muskita, 2020). At the internalization stage, it is about fostering a love for culture through introductory activities. This stage is then implemented in learning with the SSI approach.

At the scientific background stage, teachers can introduce various issues or cultures related to science. Thus, the stage of cultural literacy will begin to be developed because students at this stage will start to recognize their own culture. Then, when entering the stage of evaluation of information and impact analysis on local, national, and global levels, students will begin to analysed the situation experienced by a culture and its impact locally, globally, and nationally. So that students will understand that the existence of culture has explanations that are very complex, both from the perspective of science, society, and culture itself. Then, when students learn to enter the decision-making stage, they will make various suggestions that can be implemented related to the existing culture from the perspective of science and society, so indirectly, the teacher has guided students to build a sense of care for the culture itself while also understanding the scientific concepts within it.

Science literacy can also be integrated into the learning process. Integrating science literacy into learning makes science education clearer and more valuable (Situmorang, 2016; Wijaya et al., 2023). One of the learning methods that can integrate science literacy is learning with the SSI approach, which can also train a person's abilities and attitudes towards global culture and situations (Li & Guo, 2021). The development of science literacy in the SSI approach, when starting from a scientific background, will allow students to learn to recognize science within the context of the culture and local wisdom present in their surroundings. Then, when entering the stage of evaluation of information, students will learn science in terms of knowledge and process because in this phase, students will study the validity of culture along with the scientific aspects present in that culture. This phase also fosters one of the attitudes of scientific literacy, which is curiosity. Finally, in the decision-making phase, students will learn the scientific process of drawing conclusions and making decisions based on data, as well as developing an awareness of their social and cultural situations.

Science and culture should be instilled in harmony within education. Learning by adopting the concept of culture-based science or local science (indigenous science) will enrich students' knowledge about sociocultural aspects and relate them to scientific

concepts, resulting in cognitive assimilation or accommodation between accepted scientific concepts and scientific experiences in sociocultural situations (Harefa, 2017; Zidny et al., 2021). The researchers provided several examples related to the application of the SSI approach to instill cultural literacy and scientific literacy by taking issues or cultures present on the island of Bali as examples. First, when the teacher explains the phenomenon of erosion, the teacher can introduce the Balinese agricultural system known as Subak. Here, the teacher can involve students in researching information about Subak. Then, the teacher can pose a prompting question about how the Subak system can prevent erosion on sloped land. The student then conducted an evaluation of information to answer that. Then, in the next stage, the teacher can pose questions related to the impact of the Subak system on the social life of farmers, and the students can conduct an analysis. Finally, the teacher encouraged the students to make recommendations for preserving the Subak system when they become part of the community, such as not converting rice fields that use the Subak system and preventing excessive use of synthetic fertilizers and pesticides to avoid impacting the crops in the upstream and downstream rice fields (Windia et al., 2018). In this learning process, students will learn about scientific knowledge regarding the causes of erosion and the role of the Subak system in addressing erosion, science in the context of local culture, and also the scientific process, which involves data collection and conclusion-making, as well as the scientific attitude of curiosity and environmental concern.

The second example is in the subject of Chemistry, topic Acids, Bases, and Salts, where the teacher can start with the Balinese community's habit of using betel lime as an alternative medicine when stung by bees/wasps (Satriyanti, 2021). Students will certainly learn to recognize that the Balinese community has a culture of traditional healing. Then the teacher invites the students to analyze the reasons for using pamor as a bee sting remedy from a Chemistry perspective through the stage of evaluation of information. Then the teacher invited the students to make recommendations to the school community, either in the form of posters related to the use of pamor as first aid if stung by wasps or bees. In addition to developing cultural literacy, the aspect of science literacy is also evolving, namely conceptual and factual knowledge, science in context, and scientific attitudes.

In the learning process with the SSI approach, teachers should be able to design lessons that integrate various issues and cultures in science education but have the potential to be studied scientifically (Wijaya, 2018). In addition, teachers are also expected to provide various learning resource recommendations to students and facilitate the learning process so that the learning process becomes more optimal (Yasa et al., 2021). Then, in the evaluation stage, teachers can also incorporate HOTS questions that integrate culture and science

Science learning with the SSI approach theoretically has the potential to encounter obstacles. The obstacles that may be encountered include students' difficulties in changing their learning methods, which have been more inclined towards passive science learning, whereas the SSI approach requires students to become active learners. (Cahyani & Pranata, 2023; Sulistina et al., 2024). Additionally, in this era of globalization, students tend to feel distant or less familiar with local culture due to the influence of Westernization, which may lead to difficulties in connecting local culture with aspects of science (Vera et al., 2021).

The SSI approach has advantages compared to other learning methods in instilling cultural literacy. In this approach, students are introduced to culture at the beginning of the lesson, then invited to examine the complexities of culture, and concluded with the formulation of conclusions/policies as a form of cultural care. Whereas the learning approach/model does not have specific characteristics to initiate or design learning for cultural instillation. Then, for science literacy, the SSI approach has the same effectiveness as other teaching approaches/models because, in terms of the learning flow, it provides opportunities for students to learn all components of science literacy.

▪ CONCLUSION

Based on the discussion results, it can be concluded that cultural literacy and scientific literacy can be developed through the SSI approach. With the SSI approach, students will learn and understand that there is a connection between culture and sociocultural phenomena with scientific aspects. In the learning stages with the SSI approach, students will develop cultural literacy aspects starting from cultural introduction, cultural complexity, and ending with fostering a sense of care for culture. Additionally, from the perspective of scientific literacy, in the initial phase, students will be introduced to science in context, followed by knowledge and scientific processes, and ending with the development of a positive attitude based on science and culture.

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