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Ethnosciences learning related to socioscientific issues: Problems asked, science answered

Salma Putri Tsaniyah[1*], Wirawan Fadly[2]
[1,2]Department of Natural Science Education, Faculty of Education and Teacher Science, IAIN Ponorogo, Indonesia

*Corresponding author: salmapt9801@gmail.com

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ABSTRACT

Ethnoscience learning incorporates local cultural aspects into science education, allowing students to engage with their environment and tackle real-world challenges. This study aims to examine the impact of ethnoscience learning on socioscientific issues in enhancing student engagement and environmental problem-solving skills at SMP Ma'arif 1 Ponorogo. A mixed-method experimental design was used, with quantitative data from pretest and posttest assessments and qualitative data from student observations. The findings indicate a significant improvement in student engagement and problem-solving abilities, as reflected in higher posttest scores and active participation. Thus, ethnoscience-based learning has been proven effective in enhancing scientific literacy and ecological awareness while also providing a contextual, meaningful, and relevant learning experience for everyday life. The implications of this study suggest the potential integration of diverse cultural perspectives into science education, ensuring that students from various backgrounds have equal opportunities to develop critical thinking and problem-solving skills to address environmental and social issues.

Pembelajaran etnosains terkait dengan isu sosiosaintifik: Masalah diajukan, sains menjawab

Kata Kunci:

lingkungan, etnosains, kemampuan penyelesai masalah, sosiosaintifik

ABSTRAK

Pembelajaran etnosains mengintegrasikan aspek budaya lokal ke dalam pendidikan sains, memungkinkan siswa berinteraksi dengan lingkungan mereka dan mengatasi tantangan dunia nyata. Penelitian ini bertujuan untuk mengkaji dampak pembelajaran etnosains pada isu sosio-ilmiah dalam meningkatkan keterlibatan siswa dan keterampilan pemecahan masalah lingkungan di SMP Ma'arif 1 Ponorogo. Penelitian ini menggunakan desain eksperimen dengan metode campuran, di mana data kuantitatif dikumpulkan melalui tes awal dan tes akhir, sementara data kualitatif diperoleh dari observasi aktivitas siswa. Hasil penelitian menunjukkan peningkatan signifikan dalam keterlibatan siswa dan kemampuan pemecahan masalah, yang tercermin dari peningkatan skor tes akhir dan partisipasi aktif mereka. Dengan demikian, pembelajaran berbasis etnosains terbukti efektif dalam meningkatkan literasi sains dan kesadaran ekologis, sekaligus memberikan pengalaman belajar yang kontekstual, bermakna, dan relevan dengan kehidupan sehari-hari. Implikasi penelitian ini mencakup integrasi perspektif budaya yang beragam dalam pendidikan sains, memastikan bahwa siswa dari berbagai latar belakang memiliki kesempatan yang sama untuk mengembangkan

keterampilan berpikir kritis dan pemecahan masalah dalam menghadapi isu lingkungan dan sosial.

Contribution to the Literature

This research contributes to:

- Providing new insights into science education by integrating ethnoscience learning and socioscientific issues.
- Filling knowledge gaps and offering empirical evidence on the effectiveness of this approach in enhancing scientific literacy and ecological awareness.
- Guiding educators to design more meaningful and contextual learning experiences that integrate local knowledge, environmental concern, and social problem-solving.

1. INTRODUCTION

Learning is an interactive process involving students and teachers during teaching and learning activities. In a learning process that integrates ethnoscience or local culture, it is expected that students will be able to adapt and engage with their environment, leading to positive changes in attitudes and behavior [1], [2]. A learning process solely focused on textbooks and classroom instruction limits students' interaction with the outside world, hindering their understanding of environmental concepts. Therefore, this research is necessary to encourage students to leverage science education to study the natural environment and explore ways to apply it in their daily lives [3], [4]. Science education combining physics, chemistry, and biology concepts enhances students' experiences and abilities in understanding the natural world around them [2], [4]. Current developments in science education can draw from the uniqueness and strengths of a region, including local technology and traditional culture. By learning about their local traditions and culture, students can develop a sense of pride and connection to their country and the places where they live.

To improve learning outcomes, effective collaboration between teachers and students is essential [5], [6]. Ethnoscience learning, which incorporates aspects of local culture, can significantly improve the quality of education [7], [8]. By adapting traditional cultural practices and integrating contemporary issues, teachers can create a dynamic learning environment that motivates students to engage creatively and explore their surroundings through direct interaction [4], [7]. This approach involves translating indigenous knowledge into scientific concepts, a practice known as ethnoscience [3], [9]. Implementing ethnoscience in education can address shortcomings, such as excessive reliance on textbooks and traditional classroom activities, by offering more flexible and contextually relevant learning experiences [10]. A major challenge in education is equipping students to solve problems and make rational decisions [11], [12]. Enhancing students' reasoning skills across various levels—low, medium, or high—is crucial for navigating and resolving real-world issues [12], [13]. Thus, integrating ethnoscience enriches learning and strengthens students' critical thinking and problem-solving abilities.

Studying natural phenomena systematically is a vital aspect of learning the natural sciences. A learning activity cannot be considered as such unless it results in discoveries. This is evident in the learning process that involves ethnoscience, where the role of local culture is revived for students. The role of ethnoscience in learning can be seen when students explore local cultures linked to scientific theory. This approach not only helps

students understand the material through local culture, but in other instances, it also fosters a sense of environmental stewardship [3], [4], [6]. Concern for the environment aligns with the curriculum implemented in Indonesia, particularly the Merdeka Curriculum, which encourages science education that enables students to learn about themselves and their environment and apply their knowledge to daily life [7].

This case study designs science learning by connecting local culture to contemporary social issues [7], [8], [14]. The learning focuses on ethnoscience concepts relevant to social problems, such as the decline in the cultivation of medicinal plants. Through this process, students will indirectly enhance their problem-solving abilities [7], [8], [15]. This research is driven by the concern that, in Indonesia, education has shifted its focus away from local welfare due to rapid technological advancement. The educational system now relies heavily on technological media, often neglecting local welfare, even though local culture can significantly benefit students. When used as teaching material, local culture can educate students about the importance of preserving their heritage.

This study aims to contribute to the field of science education in Indonesia. Integrated with contemporary issues, research on science learning can yield improvements for students, especially when they are eventually confronted with challenges in contributing to their community and environment [1], [16]. Students can use their reasoning abilities to solve problems when implementing ethnoscience [17], [18]. This research underscores the need for self-reflection to assess students' attitudes toward ethnoscience learning, especially when directly confronted with current issues related to learning experiences with their local culture.

Ethnoscience is utilized in science education to integrate local culture with educational and social issues. Ethnoscience has been used to explain ecosystem concepts to students [2], [19]. By examining the habits of local people, students can gain new learning experiences. For example, science education can link local wisdom, such as Reog Ponorogo, with current debates about its recognition by neighboring countries like Malaysia [20]. These social issues allow students to develop their logical and reasoning abilities [21], [22]. Students can explore topics like biodiversity, Newton's laws, and business by connecting them with local culture. Ethnoscience-based learning provides new insights for students, enabling them to go beyond textbook material and integrate it with local culture [23]. This approach also challenges teachers to innovate by merging indigenous concepts with scientific knowledge, leading to more dynamic and effective learning. This innovation in teaching is one way of driving change in education, fostering new ideas that solve problems in the surrounding community [3], [6].

Ethnoscience expands students' knowledge of their environment, preventing them from becoming disconnected [2], [3]. Other studies have shown that integrating ethnoscience with meaningful learning can enhance students' competencies by increasing motivation and interest [1], [4], [24]. Ethnoscience education focuses on building integrated understanding rather than simply in-depth knowledge [25]. This research employs ethnoscience as a primary learning resource, addressing the often-overlooked local culture in an era of rapid technological development. When maximized as teaching material, local culture can improve students' understanding of educational content. By combining local culture with socioscientific issues, this study allows students to critically engage with their surroundings and solve problems. Through this process, students will explore their environment while addressing social issues related to it [10], [25]. This learning process integrates two key aspects of science—understanding and research—and emphasizes the relationships between science, technology, and society. The interaction between social, cultural-historical, and individual factors significantly influences human

development. Ethnoscience learning can bridge authentic science, helping students relate dynamic natural phenomena to their everyday lives [7], [10]. Complex ethnoscience learning enhances students' logical abilities, enabling them to solve problems effectively and accurately based on their understanding of data, tables, or topics discussed [9], [16].

Research related to ethnosciences has been extensively conducted, including studies on the influence of ethnosciences learning [2], ethnosciences in traditional market activities [26], the development of integrated ethnosciences learning models [27], [28], and ethnosciences as a stimulus for higher-order thinking skills [29]. However, no studies have explored the impact of ethnoscience and socioscientific issues on students' abilities. This study seeks to fill that gap by investigating how ethnoscience learning related to socioscientific issues affects students' learning outcomes. Previous research on ethnoscience has implemented it in learning but without focusing on socioscientific issues. In contrast, this research integrates ethnoscience with socioscientific issues, aiming to enhance students' abilities, such as problem-solving related to local social challenges.

2. METHOD

This study employed qualitative and quantitative methods to obtain descriptive and statistical results. The qualitative method involved interviews with cultural figures and participants engaged in environmental preservation programs in Ponorogo. The research began with identifying the research topic and objectives, which aimed to integrate local culture into ethnoscience learning [30]. Following identifying research objectives, the location was selected, participants were recruited, and the necessary permissions were obtained, all while adhering to research ethics.

The quantitative approach utilized a quasi-experimental design with a control group pretest-posttest, applied to a group of 35 randomly selected seventh-grade students from a junior high school in Ponorogo, which had implemented the Merdeka curriculum. The sample was chosen using a cluster random sampling technique [31], as the research subjects represented a larger group rather than individual cases [32]. The researchers developed an ethnoscience module, validated by experts, and implemented it over three sessions, each lasting two hours. The first session was used for a pretest, the second for ethnoscience learning related to current issues, and the third for a posttest.

Data were collected through interviews and tests. Qualitative data were analyzed using narrative techniques to explore context, timing, and cultural background. In contrast, quantitative data were analyzed descriptively using SPSS to compare pretest and posttest results without generalizing the findings. The study followed an exploratory sequential design, with qualitative analysis conducted before quantitative analysis, to offer a deeper understanding of socioscientific issue-based ethnoscience learning. Figure 1 outlines the research procedures. This approach ensures a comprehensive examination of both qualitative and quantitative dimensions of the study.

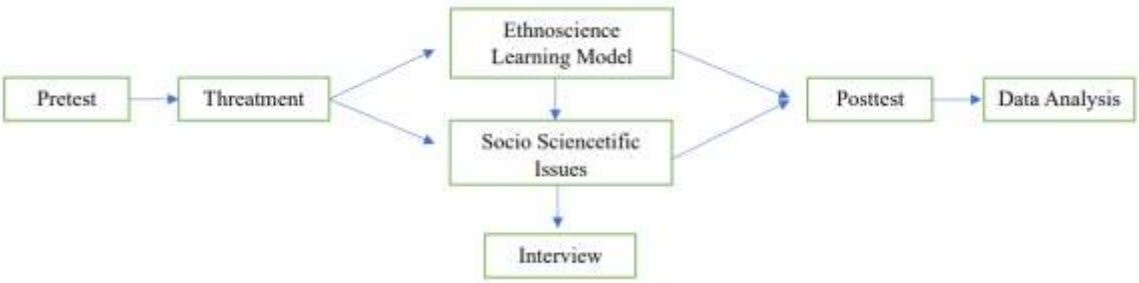

Figure 1. Research Procedure

3. RESULTS AND DISCUSSION

This research discusses a lesson in which students interact directly with their surrounding environment. The students developed an understanding of the characteristics of the environment and connected these to events or social issues related to the environmental theme. For example, ethnoscience learning at SMP 1 Ma'arif involved the environment, particularly the management of greenhouses by the entire school community. Through science education, students engage directly with the environment by observing plants, taking care of them, and classifying them based on morphology, among other activities. Reflecting on previous research, this study shares similarities, particularly in incorporating ethnoscience into learning. However, integrating ethnoscience with socio-science sets this research apart from previous studies, contributing to the student's problem-solving ability.

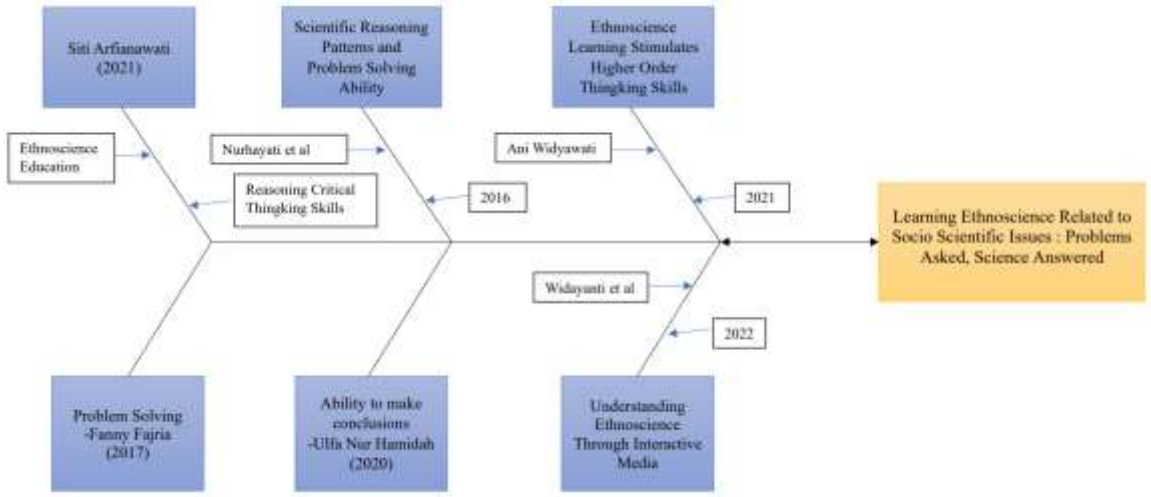

Figure 2. Visualization of the State of the Art

This study was conducted to enhance the learning process from previous research, where students demonstrated greater flexibility in learning by participating in classroom activities and directly engaging with and examining the surrounding environment [2], [33]. The fishbone diagram (Figure 2) visualizes the processes from this and previous research, highlighting similarities and differences across various aspects.

The researcher aimed to address two main questions: (1) How do students' reflection test results on ethnoscience learning, which links social issues to problem-solving, demonstrate their understanding? (2) How does applying ethnoscience learning, which connects social issues to local culture, help students understand the relationship between science and local culture? To answer these questions, the researcher identified two key findings. First, students showed interest in the learning concepts presented. Science content was easier for students to understand when it was linked to local culture, specifically through the seventh-grade ecology curriculum. Ethnoscience learning encourages students to adopt a critical mindset, enabling them to tackle learning challenges and real-world problems [6].

Initially, students took a pretest to assess their understanding of the connection between ethnoscience and current social issues. The pretest results reflected their initial knowledge before any intervention. To assess improvement, the researcher provided a series of learning activities during which students explored ecology concerning local culture. One example of this was an environmental conservation program involving the creation of greenhouses. The researcher guided students in linking the cultural practices at

school with the social issues under discussion. This approach helped develop students' problem-solving skills, which they could apply to solve challenges in their learning process. After the intervention, a posttest was administered, showing improved student outcomes from the beginning to the end of the test. A teacher stated during the interview, "The students do not only learn in the classroom; the teacher directly provides learning related to the surrounding environment."

As stated by the teacher, in this program, integrating local culture and social issues significantly increased students' motivation to learn. Students were engaged in classroom activities and encouraged to participate in hands-on learning within the school environment and observe the local culture. The implementation of ethnoscience positively impacted student development, learning outcomes, and the school community. This learning activity aligns with the Merdeka Curriculum, which emphasizes the importance of Pancasila values in addressing real-life issues, including strengthening the Pancasila profile. Through ethnoscience, students applied the principle of cooperation by working together to address environmental and cultural concerns. For instance, students collaborated to care for the plants in the school, watering them daily according to a set schedule and providing periodic fertilization. Additionally, pretests and posttests were administered to assess whether there was an improvement in learning outcomes through ethnoscience learning linked to social issues.

The researchers also interviewed teachers involved in managing the greenhouse conservation program at the school, which has been running since 2018. He stated, "The land is quite large here, so an environmental conservation program in the form of a greenhouse was created, and, thank God, it has a good impact on the entire school community." Therefore, the school sought solutions to utilize the available land to benefit the entire school community. Due to the lack of green spaces, the vacant land was designated for a greenhouse to increase plant oxygen levels and refresh the school environment. In establishing this environmental conservation program, the greenhouse was expected to be a positive learning tool for students, particularly in science education. The researchers conducted tests to assess improvements through ethnoscience learning, designed by linking social issues to the learning content. This approach allowed students to sharpen their problem-solving skills by determining appropriate strategies for addressing the problems [25], [34]. The test results revealed an average increase in students' scores, with pretest scores averaging 66.00 and posttest scores averaging 80.80. Students also viewed science as a subject rooted in their immediate environment. In particular, they learned about various types of plants around the school and how to care for them as part of the ecological materials connected to local culture.

Local culture, exemplified by the greenhouse, played a significant role in supporting students' learning. It allowed them to engage with science by actively caring for the school's ecosystem, such as watering plants and providing fertilizers to nurture plant growth. The entire school community was involved in maintaining biodiversity, and as more people became attuned to environmental concerns, the surrounding ecosystem was better preserved. This hands-on approach not only deepened students' understanding of ecological principles but also fostered a stronger sense of environmental responsibility.

The environmental conservation teacher shared, "The entire school community is involved in the environmental conservation process, and there is a lot of biodiversity in this school." The plants in the greenhouse vary, ranging from longan trees and cacti to betel nuts and red shoots. These diverse plants offer students opportunities to analyze and learn science through local cultural experiences they encounter daily. Nearly 80% of students showed interest in the ethnoscience learning process, especially as the lessons

were linked to social issues they were already familiar with, such as the Bromo mountain fire caused by human activity.

By analyzing this issue, students honed their problem-solving abilities and applied strategies based on their surroundings. This was demonstrated through their involvement in reforesting or rejuvenating the greenhouse plants, particularly those that had begun to wither. Students were taught how to fertilize plants using organic fertilizers like goat manure and liquid fertilizers made from fermented organic materials.

The administrator noted, "The environmental preservation program brings benefits and challenges, one of which is disrupting other lessons." The disruption was due to students' tardiness following plant care activities. Furthermore, their ineffective time management hindered the sustainability of the school's culture. To address this, the school leadership sought solutions to ensure all learning activities could continue effectively. They recommended providing in-depth socialization for the entire school community regarding the program and suggested scheduling greenhouse maintenance during recess or the beginning of the school day. This would help minimize disruptions and allow teachers to track whether students fulfilled their duties in maintaining the ecosystem and biodiversity.

In an interview, a teacher stated, "Ethnoscience learning benefits students when linked to social issues. They become more active in the classroom." The students adapted to their environment by paying attention to social issues. By understanding these issues, they could determine appropriate strategies to apply to the environment. Indirectly, they honed their abilities in problem-solving and understanding ecological material. Ethnoscience learning activities provided easier access for students to engage with the subject matter.

A student shared, "I am pleased. The environment around the school is cooler than before because plants are now preserved here. Various medicinal and ornamental plants are present, starting from the front gate to the center field." The presence of environmental conservation facilities, such as a greenhouse, meant students no longer needed to travel far to visit environmental preservation sites. The school culture, which emphasizes environmental sustainability, benefited students by serving as an additional learning resource [2], [9], [34]. Ethnoscience learning also imparted valuable education to students by teaching them content and promoting discipline, especially in managing time. This local school culture proves that students are not merely focused on handbooks but are encouraged to engage with the surrounding environment for their science learning process. Other school community members, including teachers and staff, responded enthusiastically to the program and contributed to maintaining the sustainability of the ecosystem.

Learning about environmental issues can be achieved through more than just classroom lectures. The learning process must be balanced to provide a deeper understanding [7], [23], [34]. These activities also offer opportunities for students to contribute to environmental protection, such as through reforestation or greening initiatives. As educators, we should use varied learning methods. We are encouraged to think creatively and develop engaging learning activities that capture students' attention and prevent boredom [5], [16]. By doing so, we can foster a sense of responsibility and active participation in environmental sustainability among students.

One of the goals of this research was to instigate a change in learning. Students collaborated directly with the surrounding environment and engaged with the phenomena or issues under discussion. Unintentionally, students began to respond thoughtfully to understand the problem and devise solutions based on the issue at hand [10]. Relying solely on textbooks for learning will not positively impact students' outcomes [9], [11].

Monotonous learning can lead to disengagement, making it difficult for teachers to manage students who lack interest in the classroom experience.

Through the ethnoscience learning, students reflected on how the activity helped them better understand the material by directly interacting with local school culture and connecting relevant scientific theories to real-world issues. They began considering possible solutions to their problems [6 - 8]. Students also started to recognize various forms of diversity in the school environment. Learning through the school's local culture made it possible to influence students' attitudes toward science education [8], [21]. This learning is easy to implement and involves simply engaging with the local culture—namely, the school's environmental conservation program, which includes a greenhouse.

One of the most interesting findings from this research is the improvement in student learning outcomes. Data processing was carried out using the SPSS program. The results showed significant improvement, as indicated by the paired sample t-test. The normality test values were 0.203 for the pretest data and 0.201 for the posttest data, confirming that the data was normally distributed.

Table 1. The Results of the Normality Test

Test	Shapiro wilk	Sample
Pretest	0.203	35
Posttest	0.201	35

The ethnoscience learning activity can significantly impact the average scores of seventh-grade students. Before this activity, students typically followed a conventional learning pattern, attending class and working through exercises based solely on a handbook. They completed questions as part of this process [2], [5], [19]. While the learning process was generally effective, not all materials were conducive to this approach. The researchers selected ecological content incorporating ethnoscience and local culture, addressing social issues that encouraged students to develop problem-solving skills related to the material [10], [21]. Students reported that this learning experience was distinct from their previous ones, leading to increased motivation and a more active, creative approach to learning [2].

Table 2. The Results of the Paired Sample t-test

Mean Pretest	Std. Deviation (Pretest)	Mean Posttest	Std. Deviation (Protest)
66.00	6.817	80.80	5.318

The ethnoscience approach to learning has been implemented in ecological material, such as maintaining biodiversity to prevent extinction and preserving the surrounding environmental ecosystem to enhance students' learning outcomes [9]. This approach involves innovative activities. Innovation in education refers to ongoing changes to make students more active, creative, and critical in responding to challenges [15]. In today's context, material-centered learning is no longer relevant. Educators must continuously develop creative solutions, such as integrating local cultural learning and social issues into ecological material. This interaction encompasses not only nature but also all members of the school community, including janitors and security guards [19]. By fostering such inclusive learning environments, students can develop a deeper understanding of the interconnectedness between culture, society, and the environment.

Table 3. Paired Sample Correlation

Test	Correlation	Sig
Pretest & Post-test	0.112	0.522

The output table of the paired sample t-test shows that the obtained Sig. value (2-tailed) is 0.000, which is less than 0.05. This indicates that ethnoscience learning positively impacts students' learning outcomes. Such learning activities should be conducted continuously, adapting the material to suit students' needs. Teachers should carefully analyze and select methods that facilitate students' understanding of the material and motivate them to engage in teaching and learning activities. In addition to the positive influence of local culture on student learning outcomes, this learning process also helps students develop their problem-solving abilities [13]. Students are introduced to ecological topics through social issues, such as the forest fire on Mount Bromo. They are tasked with analyzing these problems and determining the appropriate solutions for the surrounding environment.

Table 4. Paired Sample t-test

Test	Mean	Std. Deviation	Std. Error Mean	Sig (2-tailed)
Pretest and posttest	-14.800	8.163	1.380	0.000

In examining education in Indonesia, it is evident that many teachers need to be more active and creative in developing learning models that engage students and encourage participation. The educational innovations explored in this research should be further developed to enhance their effectiveness. Teachers designing learning models must also consider the relevance of the material to ensure that learning remains effective and benefits all participants [14], [35].

This research presents both theoretical and practical implications. Theoretically, ethnoscience learning can increase students' environmental awareness [36]. Additionally, the ability to solve problems can shape students' mindsets in addressing real-life issues [37]. There is a clear relationship between ethnoscience learning and students' problem-solving abilities. The researchers hope that ethnoscience learning will improve students' academic performance while engaging with socioscientific issues [22], [38]. Practically, this research serves as feedback for teachers and students, providing valuable insights to enhance the learning process and student achievements through ethnoscience education. The interaction between students, teachers, and the environment enriches the learning experience, moving beyond textbook and classroom limitations [2], [39]. This approach also makes it easier for students to better understand their surroundings and engage with their culture [35].

The findings of this study suggest an improvement in students' scientific literacy by utilizing ethnoscience within socioscientific contexts, which aligns with the work of Rubini *et al.* [40]. Rubini's research highlights the role of socioscientific issues in problem-based learning as an effective method for enhancing scientific literacy. Therefore, this study emphasizes integrating real-world, relevant contexts into science education to strengthen students' understanding and skills. While Rubini focused on the global warming issue in a problem-based learning context, this research incorporates ethnoscience, offering a richer local cultural context. These results demonstrate that students gain scientific knowledge and develop a deeper understanding of the social and cultural contexts surrounding the scientific issues they explore.

This research has a significant strength in its holistic approach to science education by combining ethnosciences and socioscientific issues. This enables students to better comprehend and apply scientific knowledge in broader, more relevant contexts. This integration fosters student engagement through cultural relevance and supports the development of critical thinking and problem-solving skills—essential components of 21st-century education. However, the research faces certain limitations, such as potential

restrictions on sample size and geographic scope, which may limit the generalizability of the findings. Additionally, the study does not fully examine the long-term impacts of ethnoscience in education, including how knowledge is retained and applied over time.

From a scholarly perspective, this research makes a valuable contribution by emphasizing the importance of context in science education. It demonstrates how integrating ethnosciences can make science curricula more engaging and relevant to students from diverse backgrounds. The study also presents an innovative learning model that enhances scientific literacy and student engagement, highlighting the potential for this approach to be adapted and applied in various educational settings. Thus, this research offers new insights into contextual science learning and promotes the development of teaching strategies that empower students to address complex real-world problems.

4. CONCLUSION

The analysis reveals that implementing ethnoscience learning about socioscientific issues significantly impacts student learning outcomes. This approach increases student activity and engagement, allowing them to interact directly with their environment and enrich their learning experiences beyond traditional textbook materials. It enhances students' understanding of environmental issues while developing their ability to solve real-world problems, which they can apply in everyday situations. Pretest and posttest results indicate significant improvements in students' knowledge and skills, confirming the effectiveness of integrating ethnoscience learning with social issues to enhance scientific and ecological literacy.

AUTHOR CONTRIBUTION STATEMENT

SPT contributed to conceptualization, formal analysis, the writing of the original draft, methodology, and software development. WF contributed to visualization, review writing, supervision, and project administration.

REFERENCES

[1] Hikmawati, I. W. Suastra, and N. M. Pujani, “Local wisdom in Lombok island with the potential of ethnoscience for the development of learning models in junior high school,” in The 10th International Conference on Theoretical and Applied Physics (ICTAP2020) *J. Phys. Conf. Ser.*, 2021, pp. 1-13, doi: 10.1088/1742-6596/1816/1/012105.

[2] R. A. Fasasi, “Effects of ethnoscience instruction, school location, and parental educational status on learners’ attitude towards science,” *Int. J. Sci. Educ.*, vol. 39, no. 5, pp. 548–564, 2017, doi: 10.1080/09500693.2017.1296599.

[3] Y. F. Kasi, A. Samsudin, A. Widodo, and R. Riandi, “A thematic review on exploring ethnoscience in science education: A case in Indonesia,” *Tadris J. Kegur. Dan Ilmu Tarb.*, vol. 6, no. 2, pp. 229–241, 2021, doi : 10.24042/tadris.v6i2.9509.

[4] E. Wati, Yuberti, A. Saregar, M. I. Fasa, and A. Aziz, “Literature research: Ethnoscience in science learning,” in Young Scholar Symposium on Science Education and Environment (YSSSEE) 2020 *J. Phys. Conf. Ser.*, 2021, pp, 1-10, doi: 10.1088/1742-6596/1796/1/012087.

[5] E. Koçak, A. Yalçin ÇeliK, and Ç. Uluyol, “Pre-service Teachers’ environmental literacy: The role of STEM-Based environmental education with microcontrollers,” *Particip. Educ. Res.*, vol. 10, no. 5, pp. 233–247, 2023, doi: 10.17275/per.23.84.10.5.

[6] M. Kubsch, D. Fortus, K. Neumann, J. Nordine, and J. Krajcik, "The interplay between students' motivational profiles and science learning," *J. Res. Sci. Teach.*, vol. 60, no. 1, pp. 3–25, 2023, doi: 10.1002/tea.21789.
[7] A. T. Kinslow, T. D. Sadler, and H. T. Nguyen, "Socioscientific reasoning and environmental literacy in a field-based ecology class," *Environ. Educ. Res.*, vol. 25, no. 3, pp. 388–410, 2018, doi: 10.1080/13504622.2018.1442418.
[8] C. A. Dewi, Y. Khery, and M. Erna, "An ethnoscience study in chemistry learning to develop scientific literacy," *J. Pendidik. IPA Indones.*, vol. 8, no. 2, pp. 279-287, 2019, doi: 10.15294/jpii.v8i2.19261.
[9] R. Zidny and I. Eilks, "Learning about pesticide use adapted from ethnoscience as a contribution to green and sustainable chemistry education," *Educ. Sci.*, vol. 12, no. 4, pp. 1-16, 2022, doi: 10.3390/educsci12040227.
[10] R. Khishfe, "Consistency of nature of science views across scientific and socioscientific contexts," *Int. J. Sci. Educ.*, vol. 39, no. 4, pp. 403–432, 2017, doi: 10.1080/09500693.2017.1287976.
[11] R. M. Molinini, "Measuring early problem-solving in young children with motor delays: A validation study," *Phys. Occup. Ther. Pediatr.*, vol. 41, no. 4, pp. 390–409, 2021, doi: 10.1080/01942638.2020.1865501.
[12] Y. N. Pratiwi, S. Rahayu, and F. Fajaroh, "Socioscientific issues (SSI) in reaction rates topic and its effect on the critical thinking skills of high school students," *J. Pendidik. IPA Indones.*, vol. 5, no. 2, pp. 164-170, 2016, doi : 10.15294/jpii.v5i2.7676.
[13] R. W. Weisberg, "Toward an integrated theory of insight in problem solving," *Think. Reason.*, vol. 21, no. 1, pp. 5–39, 2015, doi: 10.1080/13546783.2014.886625.
[14] K. J. Gilhooly, G. J. Georgiou, M. Sirota, and A. Paphiti-Galeano, "Incubation and suppression processes in creative problem solving," *Think. Reason.*, vol. 21, no. 1, pp. 130–146, 2015, doi: 10.1080/13546783.2014.953581.
[15] R. Levinson, P. Kent, D. Pratt, R. Kapadia, and C. Yogui, "Developing a pedagogy of risk in socioscientific issues," *J. Biol. Educ.*, vol. 45, no. 3, pp. 136–142, 2011, doi: 10.1080/00219266.2011.576260.
[16] L. F. Main, M. A. B. Delcourt, and D. J. Treffinger, "Effects of group training in problem-solving style on future problem-solving performance," *J. Creat. Behav.*, vol. 53, no. 3, pp. 274–285, 2019, doi: 10.1002/jocb.176.
[17] W. Mudana, "The effect of ethnoscience-based course review horay learning towards cultural concept understanding and science process skills of the elementary school students," *Nurture*, vol. 17, no. 2, pp. 137-148, 2023, doi: 10.55951/nurture.v17i2.253.
[18] N. Nurhayati, L. Yuliati, and N. Mufti, "Pola Penalaran Ilmiah dan Kemampuan Penyelesaian Masalah Sintesis Fisika," *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, vol. 1, no. 8, pp. 1594-1597, 2016, doi : 10.17977/jp.v1i8.6674.
[19] S. Sudarmin, Rr. S. E. Pujiastuti, R. Asyhar, A. Tri Prasetya, S. Diliarosta, and A. Ariyatun, "Chemistry project-based learning for secondary metabolite course with ethno-STEM approach to improve students' conservation and entrepreneurial character in the 21st century," *J. Technol. Sci. Educ.*, vol. 13, no. 1, pp. 393-409, 2023, doi: 10.3926/jotse.1792.
[20] Supriono, M. Iqbal, A. Kusumawati, and M. R. A. Fahmi, "The role of authenticity on revisit intention: Tourist experience as a mediation at the Reyog Ponorogo national festival," *Int. J. Event Festiv. Manag.*, vol. 14, no. 3, pp. 344–362, 2023, doi: 10.1108/IJEFM-09-2022-0069.

[21] M. Lindfors, M. Bodin, and S. Simon, "Unpacking students' epistemic cognition in a physics problem-solving environment," *J. Res. Sci. Teach.*, vol. 57, no. 5, pp. 695–732, 2020, doi: 10.1002/tea.21606.
[22] J. A. Luft, D. Hanuscin, L. Hobbs, and G. Törner, "Out-of-Field teaching in science: An overlooked problem," *J. Sci. Teach. Educ.*, vol. 31, no. 7, pp. 719–724, 2020, doi: 10.1080/1046560X.2020.1814052.
[23] U. N. Hamidah and F. A. Mubarak, "Analysis of students' ability to making conclusions in learning of static electricity," *INSECTA Integr. Sci. Educ. Teach. Act. J.*, vol. 1, no. 1, pp. 1-16, 2020, doi: 10.21154/insecta.v1i1.2079.
[24] P. W. Hastuti, W. Setianingsih, and E. Widodo, "Integrating inquiry based learning and ethnoscience to enhance students' scientific skills and science literacy," *J. Phys. Conf. Ser.*, vol. 1387, no. 1, pp. 1-7, 2019, doi: 10.1088/1742-6596/1387/1/012059.
[25] J. Munthahana and M. T. Budiarto, "Ethnomathematics exploration in Panataran Temple and its implementation in learning," *Indones. J. Sci. Math. Educ.*, vol. 3, no. 2, pp. 196–209, 2020, doi: 10.24042/ijsme.v3i2.6718.
[26] R. L. Alfian, "Fish species, traders, and trade in traditional market: Case study in Pasar Baru, Balikpapan City, East Kalimantan, Indonesia," *Biodiversitas J. Biol. Divers.*, vol. 21, no. 1, pp. 393-406, 2020, doi: 10.13057/biodiv/d210146.
[27] S. Prayogi, S. Ahzan, I. Indriaturrahmi, J. Rokhmat, and N. N. S. P. Verawati, "Dynamic blend of ethnoscience and inquiry in a digital learning platform (e-learning) for empowering future science educators' critical thinking," *J. Educ. E-Learn. Res.*, vol. 10, no. 4, pp. 819–828, 2023, doi : 10.20448/jeelr.v10i4.5233.
[28] P. W. Hastuti, W. Setianingsih, and E. Widodo, "Integrating inquiry based learning and ethnoscience to enhance students' scientific skills and science literacy," *J. Phys. Conf. Ser.*, vol. 1387, no. 1, pp. 1-7, 2019, doi: 10.1088/1742-6596/1387/1/012059.
[29] J. Irawan and A. Hakim, "Development of etnoscience-based natural resources chemistry practicum guideline," in Computational Intelligence And Network Security *AIP Conf. Proc.*, 2023, pp. 1-8, doi: 10.1063/5.0123061.
[30] C. A. McKim, "The value of mixed methods research: A mixed methods study," *J. Mix. Methods Res.*, vol. 11, no. 2, pp. 202–222, 2017, doi: 10.1177/1558689815607096.
[31] M. Maciejewski, "Quasi-experimental design," *Biostat. Epidemiol.*, vol. 4, pp. 1–10, 2018, doi: 10.1080/24709360.2018.1477468.
[32] S. Abutabenjeh and R. Jaradat, "Clarification of research design, research methods, and research methodology: A guide for public administration researchers and practitioners," *Teach. Public Adm.*, vol. 36, no. 3, pp. 237–258, 2018, doi: 10.1177/0144739418775787.
[33] S. Susanti, A. Asyhari, and R. Firdaos, "Efektivitas LKPD terintegrasi nilai islami pada pembelajaran berbasis masalah untuk meningkatkan kemampuan literasi sains," *Indones. J. Sci. Math. Educ.*, vol. 2, no. 1, pp. 64–78, 2019, doi: 10.24042/ijsme.v2i1.3987.
[34] A.-M. Kennedy, S. Kapitan, N. Bajaj, A. Bakonyi, and S. Sands, "Uncovering wicked problem's system structure: Seeing the forest for the trees," *J. Soc. Mark.*, vol. 7, no. 1, pp. 51–73, 2017, doi: 10.1108/JSOCM-05-2016-0029.
[35] B. Brown, G. Pérez, K. Ribay, P. A. Boda, and M. Wilsey, "Teaching culturally relevant science in virtual reality: 'When a problem comes, you can solve it with science,'" *J. Sci. Teach. Educ.*, vol. 32, no. 1, pp. 7–38, 2021, doi: 10.1080/1046560X.2020.1778248.

[36] C. C. A. Dewi, M. Erna, Martini, I. Haris, and I. N. Kundera, "The effect of contextual collaborative learning based ethnoscience to ıncrease student's scientific literacy ability: Research Article," *J. Turk. Sci. Educ.*, vol. 18, no. 3, pp. 525-541, 2021, doi : 10.36681/tused.2021.88.

[37] W. Winarto, S. Sarwi, E. Cahyono, and W. Sumarni, "Developing a problem-solving essay test instrument (PSETI) in the instruction of basic science concepts in ethnoscience context," *J. Turk. Sci. Educ.*, vol. 19, no. 1, pp. 29-51, 2022, doi: 10.36681/tused.2022.108.

[38] B. M. Martinelli and U. Euzébio, "Contribuições do pensamento decolonial sobre a ciência e sua práxis no contexto de povos e comunidades tradicionais," *Desenvolv. E Meio Ambiente*, vol. 60, no. 1, pp. 214-232, 2022, doi: 10.5380/dma.v60i0.78111.

[39] E. Hariyono, I. A. Rizki, D. A. Lestari, N. F. Citra, A. N. Islamiyah, and A. I. Agusty, "Engklek game ethnoscience-based learning material (EGEBLM) to improve students' conceptual understanding and learning motivation," *J. Pendidik. IPA Indones.*, vol. 12, no. 4, pp. 635–647, 2023, doi: 10.15294/jpii.v12i4.43941.

[40] B. Rubini, D. Ardianto, S. Setyaningsih, and A. Sariningrum, "Using socioscientific issues in problem based learning to enhance science literacy," in International Seminar on Science Education *J. Phys. Conf. Ser.*, 2019, pp. 1-5, doi: 10.1088/1742-6596/1233/1/012073.