

Ethnoscience learning related to socio-scientific issues: Problems asked, science answered

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ABSTRACT

This study employs both quantitative and qualitative methods within an experimental setting. The study was conducted at Ma'arif 1 Junior High School in Ponorogo and focused on the influence of ethnoscience-based learning in ecology. The findings indicate a significant improvement in students' learning activities and their ability to address real environmental problems. Pre-test and post-test analyses revealed a substantial difference in learning outcomes, affirming that the integration of ethnoscience and social issues can enhance students' understanding and application of scientific knowledge in real and current contexts. This research implies the efficacy of ethnoscience as an effective means in science education to enhance students' scientific literacy and ecological awareness.

Pembelajaran etnosains yang berkaitan dengan *socio scientific issues*: Masalah bertanya, sains menjawab

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ABSTRAK

Penelitian ini menggunakan metode kuantitatif dan kualitatif dalam setting eksperimental. Penelitian dilaksanakan di SMP Ma'arif 1 Ponorogo dengan fokus pada pengaruh pembelajaran berbasis etnosains dalam materi ekologi. Hasil menunjukkan peningkatan signifikan dalam aktivitas belajar siswa dan kemampuan mereka dalam memecahkan masalah lingkungan nyata. Analisis pre-test dan post-test memperlihatkan perbedaan yang signifikan dalam hasil belajar, menegaskan bahwa integrasi etnosains dan isu sosial dapat memperkaya pemahaman siswa serta aplikasi ilmu pengetahuan dalam konteks nyata dan aktual. Penelitian ini memberi implikasi pada penggunaan etnosains sebagai sarana efektif dalam pendidikan sains untuk meningkatkan literasi ilmiah dan kesadaran ekologis siswa.

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1. INTRODUCTION

Learning is an interaction process that involves students and teachers in teaching and learning activities. In a learning process that links ethnoscience or local culture, it is hoped that students will be able to adapt and interact with the environment, resulting in positive changes in attitudes and behavior [1], [2]. The learning process that only pivots on books and learning in the classroom makes students lack interaction with the outside environment and makes their understanding of environmental material. This research needs to be done so that students take advantage of learning in science subjects to study the natural environment and find ways to apply it in everyday life [3], [4]. Science learning combining

physics, chemistry, and biology concepts can increase students' experience and abilities in understanding the surrounding natural environment [2], [4]. The current development of science education can be based on the uniqueness and advantages of a region, including local technology and (traditional) culture. Students can learn to love their country and the place they live in if they learn about their local traditions or culture.

In the learning process, teachers and students must improve student learning outcomes [5], [6]. Ethnoscience learning involves aspects of local culture that can be used to improve the quality of learning [7], [8]. The learning process, in which the teacher tries to modify the existing culture at school and the issues that are currently being discussed, makes students actively creative in understanding and examining directly by interacting with the environment [4], [7]. Modifying indigenous science, which develops in the community and is used as scientific knowledge, can be called ethnoscience [3], [9]. Linking ethnoscience learning can reduce weaknesses in the world of education, such as the learning process in the classroom, which still leads to activities by student or teacher guidebooks, resulting in a need for more modification in learning [10]. Apart from that, producing students who can solve problems and make rational decisions is a big problem or challenge for the world of education [11], [12]. One of them is the ability of students to elaborate reasoning abilities in various aspects, such as problem-solving if students are faced with problems around them. This includes improving and honing students' abilities in reasoning or logic at low, medium, and high levels [12], [13].

Learning about natural phenomena systematically is an important part of studying natural sciences (science). Without discovering something new, the activity cannot be called learning. As is the case in this learning process involving ethnoscience, where the role of local culture is grown back to students. The role of ethnoscience in learning can be seen in students exploring local culture that is linked to scientific theory, where in addition to students being able to understand the material through local culture, in other cases, students are able to instill a caring nature for the environment [3], [4], [6]. Concern for the environment is also in accordance with the curriculum applied to education in Indonesia, the Merdeka Curriculum. Science education is expected to provide opportunities for students to learn about themselves and their environment and to apply knowledge in everyday life [7].

In this case study, science learning was designed to refer to local culture and link it to social issues [7], [8], [14]. This learning will center on ethnoscience concepts that are relevant to social problems so that students will face social problems or conflicts related to local culture, such as the decline in the cultivation of medicinal plants. Students in the science learning process will indirectly increase their ability to solve problems [8], [15]. This research is motivated by education in Indonesia, which has begun to forget about local welfare due to the rapid development of technology. The learning system also uses technological media and ignores local welfare. In fact, local culture can positively impact students. Apart from being open material, local culture can educate students that having a high sense of concern for local culture is one way to preserve it.

This study seeks to contribute to the field of science education in Indonesia. Research on science learning, linked to issues currently being discussed, can bring improvements to students, especially when one day they are faced with difficult conditions in contributing to the community environment [1], [16]. Students can use their reasoning abilities to solve problems when implementing ethnoscience learning [17], [18]. Through this research, self-alignment is needed to describe students' attitudes towards ethnoscience learning who are directly faced with current issues related to learning experiences with their local culture.

Ethnoscience is used in science learning as a new resource that collaborates local culture with educational and social issues. Ethnoscience learning has been used to explain ecosystem concepts to students [2], [19]. By relating people's living habits, students can provide new learning experiences. For example, science learning links local wisdom such as Reog Ponorogo, which currently coincides with the rumors that Reog Ponorogo is recognized by neighboring countries, namely Malaysia [19]. The issues faced provide opportunities for students to hone their abilities in utilizing logic and reasoning [20], [21]. They can learn science by linking it to the themes of biodiversity, Newton's law, and business. The implementation of ethnoscience-based learning provides new learning to students so that they not only focus on the material in the book but also integrate it with local culture [22]. The ethnoscience learning aspect, packed with current culture and issues, also hones the teacher's ability to unite indigenous concepts with scientific knowledge. This learning process makes teachers more innovative in terms of learning. This learning innovation is one way of making changes, ideas, or concepts in intelligent thinking, which are then implemented in education to solve a problem in the surrounding community [3], [6].

Ethnoscience can expand students' overall knowledge about their environment to avoid being alienated from their environment [2], [3]. Other relevant research has revealed that meaningful learning with the association of ethnoscience can improve students' competencies because ethnoscience learning can increase encouragement and interest [4], [23]. Ethnoscience learning focuses on integrated understanding rather than just in-depth understanding [24]. The learning in this research uses ethnoscience as a source of students' learning. Most of the time, with the rapid development of technology, local culture is not being paid attention to, even though culture can be maximized as teaching material for students to understand learning material. The researcher combines local culture with socio-scientific to make students better understand the meaning of material that is integrated with culture. Therefore, they can think critically about their surroundings and make them solve problems through the ethnoscience learning process linked to social issues. In this case, students directly explore the surrounding environment while studying problems or social issues related to the environment [10], [24]. In this learning process, students will learn two important aspects of science, namely understanding and research. Developing relationships between science, technology, and society is important in studying natural sciences. The interaction between interpersonal (social), cultural-historical, and individual factors greatly influences human development. Ethnoscience learning can bridge genuine science. Science learning must be related to dynamic natural phenomena and their relationship to everyday life [7], [10]. Complex ethnoscience learning positively impacts students in improving their logical abilities according to their understanding, which ultimately results in students solving problems related to the issues they face. Students can demonstrate high-level logic or reasoning skills effectively and accurately regarding the validity of the data, tables, or topics discussed [9], [16].

Research related to ethnoscience has been extensively conducted, including studies on the influence of ethnoscience learning [1], ethnoscience in traditional market activities [2], the development of integrated ethnoscience learning models [4], [8], and ethnoscience as a stimulus for Higher-Order Thinking Skills (HOTS) [9]. However, there has been no research examining the influence of ethnoscience and sociosciences on students' abilities. This study aims to investigate the impact of ethnoscience learning related to socio-scientific issues on learning outcomes. In previous studies, ethnoscience were implemented in the learning process but did not focus on socio-scientific issues. In contrast, this research involves collaboration between ethnoscience and sociosciences,

which will enhance students' abilities, such as problem-solving related to social issues in their surroundings.

Contribution to the Literature

This research contributes to:

- Providing new insights into science education by integrating ethnoscience learning and socio-scientific 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.

2. METHOD

This research employed qualitative and quantitative methods to provide accurate results both descriptively and statistically. In the qualitative method, this research was carried out by interviewing related parties, such as local cultural figures or environmental conservation program actors in the form of greenhouses, as people who understand the culture that will be associated with ethnoscience learning [25]. Meanwhile, in the quantitative method, researchers used a quasi-experimental approach with the control group pretest and posttest design. This method can only be applied to one research group after treatment has been given. In terms of sample selection, the researchers were appointed randomly [26].

In the implementation of the research, the researchers used a combination of two methods, namely qualitative & quantitative. The researchers used mixed methods with the exploratory sequential design technique. The researchers, who were science education students at one of the Ponorogo state universities, started the research by involving related parties, such as secondary schools. From three classrooms of seventh grade (118 students) in one of the Ponorogo secondary schools, 35 students participated in this research. In this research, the researchers used the cluster random sampling technique. The researchers used this technique because the object under study was a large group rather than an individual [27]. This research was adjusted to the methods or data collection techniques designed by the researchers. Since mixed methods can improve the understanding given to students, students need to benefit from the application of mixed methods [28].

Students follow the research process by applying ethnoscience learning or local culture familiar to them because local culture has gone hand in hand with us, so the learning process can take place according to real events. The school involved in this study has a background as a driving school, transformed from the 2013 curriculum to the Merdeka curriculum. This secondary school in Ponorogo is strategically located in the city center. Not only the school involved but also the Ponorogo culturists were chosen as informants because they are relevant figures who understand local cultures.

The researchers conducted various data source collection techniques to provide students with an understanding of ethnoscience learning linked to current social issues and stimulate students to analyze and solve the problems they face. The data sources included interviews and tests. Before this research began, the researchers developed a learning module that would be adapted to the research concept. This development process required mutual communication between science teachers and students to get modules that are appropriate and have been validated by experts. After the developed module was validated,

the application process was done according to the predetermined object and method. This study was conducted to determine the results of the ethnoscience learning process and whether it optimized student learning outcomes. Application to students was carried out for three meetings. Each meeting lasted for two lesson hours in science subjects. One meeting was utilized to conduct a pre-test for the specified students, and the second meeting was used for the ethnoscience learning process associated with current issues. The last meeting was a posttest to get the study results.

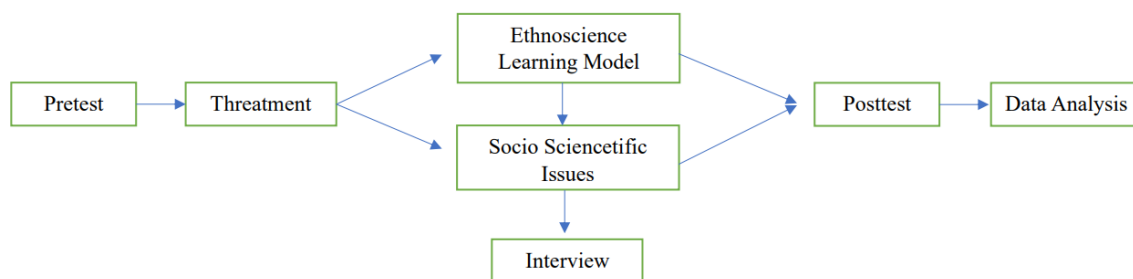


Figure 1. Research procedure

This interview was conducted with one object: the cultural activist teacher at the middle school. The interview with the teacher was aimed at knowing the development of the environmental preservation program in the form of this greenhouse. Then, from the interview results, the ethnoscience learning process, which was related to current issues, was applied. Here, students not only learn science but also about their culture. They analyzed and provided solutions to issues discussed. Not only that, interviews with cultural activist teachers at one of the secondary schools in Ponorogo add to the results of the literature described in this research. The information that researchers obtained from the school culture activist teacher was about local culture to be applied to students.

The data collection process used qualitative methods, such as narrative analysis. The researchers revealed the research results in descriptive reports. Narrative analysis has important data that relates not only to context but also to time, place, product specifications, product usage experience, and suggestions that may be considered. These aspects make the narrative analysis more accurate.

In the quantitative method, statistical analysis was used, assisted by the SPSS application. The type of statistical analysis used was descriptive statistical analysis without concluding these results in general. In this research, the researchers used mixed methods with the exploratory sequential design that prioritizes the analysis of qualitative data and then the analyses of quantitative data [29]. Through this descriptive statistical analysis technique, the researcher explained the data from the pre-test and post-test results, and a comparison was made between the two data obtained without being generalized.

3. RESULTS AND DISCUSSION

This research discussed a lesson where students interact directly with the surrounding environment. The students understood the characteristics of the environment and related them to events or social issues relevant to the environmental theme. For example, ethnoscience learning at SMP 1 Ma'arif involved the environment, namely the management of greenhouses carried out by the entire school community. The students, through science learning, interacted directly by observing plants, taking care of the plants, classifying plants based on morphology, etc. Reflecting on previous research, this research certainly has similarities, namely the involvement of ethnoscience in the learning process.

However, the collaboration between ethnoscience and socio-science differs this research from the previous ones, which leads to the ability of students to solve problems.

This learning was done as an effort to maximize the process of previous research where students are more flexible in learning because they learn not only in the classroom but also understand and examine the environment directly [2], [30], [31]. The fishbone below visualizes the process of this research and previous research, which have similarities and differences in each aspect.

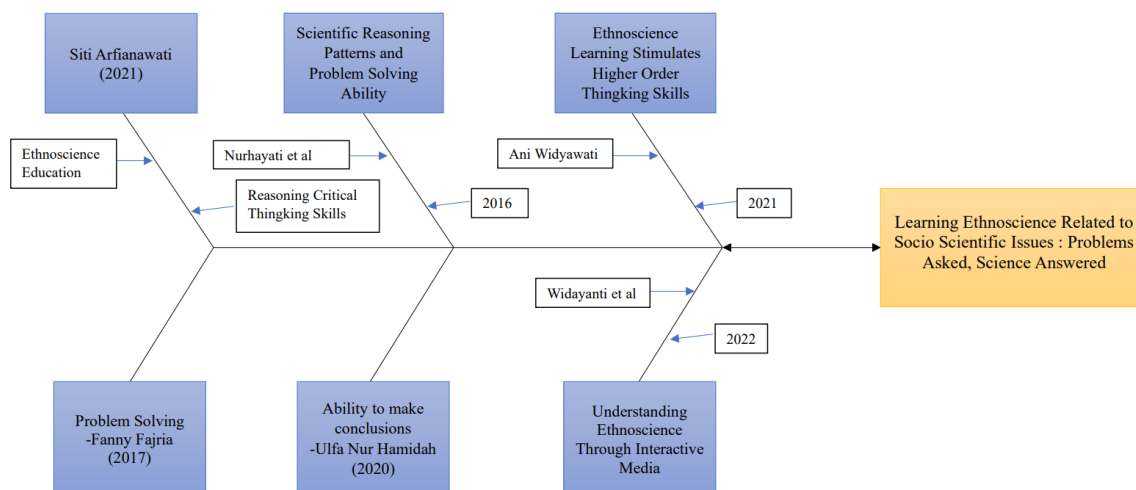


Figure 2. Visualization of the state of the art

The researcher seeks to explore the two main questions: (1) How do students' reflection test results regarding ethnoscience learning that links social issues to be able to solve a problem? (2) How do students, due to the application of ethnoscience learning that links to social issues, understand the relationship between science and local culture? The researcher found two discussions to answer these main questions. The students were interested in the learning concepts presented. Science learning was easier to understand because of the association of local culture at school with one of the seventh-grade learning materials, ecology. Ethnoscience learning leads students to a critical mindset so that they can solve learning and problems in the process [6], [32].

When the students were initially given a pre-test, they needed to recognize or understand the connection between ethnoscience learning relevant to current social issues. Therefore, the initial test results were purely students' understanding before treatment. Then, to see if there was an improvement, the researchers provided a different treatment by conducting learning activities. In these activities, the researchers provided direction on the ecology material associated with the existing culture. The culture was the environmental conservation program in the form of greenhouses. Then, the researcher, in his direction, linked the culture developed in this school with the issues discussed. This learning process certainly honed students' problem-solving skills, which they can later apply strategies for solving the problems they face. The results showed that after being given treatment and given a post-test, there was an increase in learning outcomes from the beginning to the end of this test.

"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, local culture and social issues have increased motivation in learning because they were not only invited to take part in learning activities in the classroom but also to learn directly in the school environment and observe

the local culture. The implementation of this ethnoscience had a very positive impact on students' development, learning, and schools. Indirectly, this learning activity is in line with the Merdeka Curriculum. In the Merdeka curriculum, students learn Pancasila values related to issues in everyday life, including strengthening the Pancasila profile. Students can implement the principle of cooperation in learning through ethnoscience. Ethnoscience learning linked to social issues can reinforce students' cooperation attitudes. Students work together to protect the surrounding environment and local culture. They worked together to care for all the plants in the school, such as watering the plants every day according to a predetermined schedule and providing fertilizer periodically. Apart from that, students were given a pre-test and post-test to see whether there was an increase in learning outcomes through ethnoscience learning related to social issues. The researchers conducted interviews with teachers managing the conservation program of greenhouses in this school.

The environmental conservation program of greenhouses has been going on since 2018.

"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 looked for solutions to utilize the land to provide benefits to the entire school community. Because this school lacked a green area, the empty land was intended for a greenhouse. This greenhouse hoped to increase plant oxygen levels to refresh the school environment. In establishing this environmental conservation program, the greenhouse could positively impact students as a learning medium related to science learning. The researchers administered tests to find out the improvement through ethnoscience learning.

Moreover, this learning was packaged by linking social issues. The students can hone their problem-solving skills to determine strategies appropriate to the problem at hand [24], [33], [34]. From the calculations, the test results showed the average value of pretest (before treatment) and posttest (after treatment) ($66.00 < 80.80$).

Students also described their view of science as a subject-centered on their surrounding environment. In fact, in learning about local school culture associated with social issues in ecological material, they learned about various types of plants and how to care for plants found at school. This certainly leads to the reference material, namely caring for biodiversity in the school environment through local culture.

Local culture in the form of a greenhouse is very helpful for students in the learning process. They can utilize this program as a learning medium, especially in science subjects. They are taught to care for the ecosystem in the surrounding environment by watering the plants and providing fertilizer to add plant nutrients.

In addition to biodiversity, this school involves the entire school community in maintaining biodiversity. More and more people are becoming sensitive to the surrounding environment so that the surrounding ecosystem is maintained.

The environmental conservation teacher at this school said,

"The whole school community is involved in the environmental conservation process, and there is a lot of biodiversity in this school."

In addition to the biodiversity maintained, this school involves the entire school community to maintain biodiversity. More and more people are becoming sensitive to the surrounding environment so that the surrounding ecosystem is maintained. The plants in this greenhouse vary, ranging from large to small. There are longan trees, cacti, betel nuts, and red shoots. From these various plants, students can analyze and learn science from the local culture that goes hand in hand with them daily.

Judging from the ethnoscience learning process associated with social issues, students are almost 80% interested because when the learning took place, they responded to several social issues they already knew and followed the news circulating. They can analyze the issue discussed, namely the Bromo mountain fire due to human activity.

The students can analyze and understand a problem that arises from the event. Not only that, in honing the ability to solve problems, students can also apply the strategies they choose by adjusting to their surrounding environment. This application can be implemented in the culture that has developed at school, namely the existence of an environmental conservation program in the form of a greenhouse. Students carry out the application by reforesting or greening the greenhouse or plants that have begun to wither. In the learning process, they carried out the application by bringing various plants and caring for the biodiversity. The students were taught to fertilize. Fertilizers were provided by the school in the form of organic and easy-to-find fertilizers, namely goat manure and liquid fertilizers obtained from fermentation of the remains of organic materials.

The environmental preservation administrator also said that:

"The environmental preservation program brings pros and cons, one of which disrupts other lessons."

The disruption was the students' tardiness after taking care of the plants. Not only that, their discipline in dividing time was less effective, creating obstacles to the sustainability of a good school culture. Seeing these conditions, the authorized school parties looked for solutions so that all learning activities could continue running effectively. All parties or the school community should be given in-depth socialization related to this program. This program can bring schools to the Adiwiyata school event. The important thing about this program is that it benefits students in learning activities and schools. A clear schedule can be applied to students to overcome student tardiness in entering other subject lesson hours. For example, greenhouse maintenance occurs during recess or at the beginning of students' arrival at school. Establishing a schedule can make it easier for teachers to check whether students have fulfilled their duties in maintaining ecosystems and biodiversity.

"Ethnoscience learning that is linked to social issues in society benefits students. They are becoming more active in the classrooms."

The students directly adapted to the surrounding environment by paying attention to the social issues. By understanding the social issues, the students determined the appropriate strategy to be applied to the surrounding environment. Indirectly, they can hone their abilities in two ways: solving problems and understanding the material from ecology. Conducting ethnoscience learning activities provided easier access to students in learning.

"I am pleased. The environment around the school is cooler than before because plants are now preserved here. Various plants, from medicinal to ornamental, are here, starting from the front gate to the center field."

The existence of environmental conservation empowerment facilities in the form of a greenhouse made students not need to go far to visit environmental preservation places because the culture that develops in schools can benefit students as additional learning media [1], [9], [31]. Ethnoscience learning also provides important education to students, not only referring to the material but also teaching students to practice discipline towards the time. Learning local school culture proves that students are not only fixated on student handbooks, but approaches through the surrounding environment can be done for the science learning process. Other school communities, such as teachers and staff, responded to this program very enthusiastically to contribute to maintaining and caring for the sustainability of the ecosystem.

In reality, the learning process on environmental material can be done through more than lectures in the classroom. The learning must be balanced to provide a better understanding [7], [22], [31]. These activities can also be understood by protecting the surrounding environment through reforestation or greening activities. As educators, we should use more varied learning methods. We, as educators, are encouraged to think creatively in developing a learning activity that attracts students' attention and does not make them bored [5], [16].

One of the things done in this research is also an act of change in learning. Students collaborate directly with the surrounding environment and phenomena or issues being discussed. Inadvertently, students will respond and think to understand the problem to get a problem-solving strategy by the problem at hand [10]. Learning, if it relies on books alone, will not positively impact student learning outcomes [9], [11]. Learning is monotonous, and the teacher will have difficulty conditioning students if they are not interested in the learning process in the classroom.

Through the ethnoscience learning process, the students can reflect that this activity helps them to better understand the material by directly interacting with local cultures in the school and linking relevant science theories with the material. They can relate it to the issues currently faced and begin to think about providing solutions [6]–[8]. Students also began to identify various kinds of diversity that exist in the school environment. With the help of learning through local culture in schools, it is possible to influence students' attitudes towards science learning [8], [20]. This learning is easy to do; one only needs to go directly to the school environment, which is the local culture, namely the environmental conservation program in the form of a greenhouse.

One of the interesting results of this research is the test outcome. The ethnoscience learning process states an increase in student learning outcomes. The SPSS program assisted the data processing process in this research. The results show that learning has increased based on the results of the paired sample t-test. The normality test value obtained was 0.203 in the pretest data and 0.201 in the post-test data. Therefore, the data was normally distributed.

Table 1. Test of normality

Test	Shapiro wilk	Sample
Pretest	0.203	35
Posttest	0.201	35

The ethnoscience learning activity can make a difference in the average score of seventh-grade students. In contrast, before doing this activity, the students tended to follow the learning pattern only in class and were only given a handbook. They then worked on questions [1], [5], [17]. The learning process can be generally done, but not all materials can apply this process. The researchers chose ecological material that combined ethnoscience or local culture with social issues that can hone students' abilities in solving problems that refer to the material [10], [20]. The students felt that this learning was different than before and increased their motivation to learn to be more active and creative [1].

Table 2. Paired sample t-test result

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

Ethnoscience approach to learning has been carried out in ecological material; for example, maintaining biodiversity so that it does not become extinct and maintaining the surrounding environmental ecosystem to improve student's learning outcomes [9]. This learning activity includes innovation activities. Innovation in education is a change that must continue to make students more active, creative, and think critically in responding to problems [15]. Nowadays, the material-centered learning is no longer relevant. Educators today need to rack their brains to foster bright ideas, such as the association of local cultural learning and social issues within ecological material. This interaction involves not only nature but also all people or school communities, including janitors and school security guards [19].

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, less than 0.05. Therefore, ethnoscience learning has a positive impact on students' learning outcomes. Learning activities like this must be carried out continuously by adjusting the material to be delivered to students. Teachers analyze in advance the methods that are suitable for use so that students can understand the material and be motivated to participate in teaching and learning activities at school. Not only does local culture positively influence student learning outcomes, but this learning process also trains students to develop their problem-solving abilities [6], [13]. Students learn about ecological material through social issues, such as the forest fire on Mount Bromo. The students were faced with these problems, analyzed the problems, and determined the appropriate solution to be applied to the surrounding environment.

Table 4. Paired Sample t-test

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

When looking at education in Indonesia, most teachers need to be more active and creative in creating learning models that make students more interested in participating in learning activities. Educational innovations carried out in this research need to be developed better. Teachers creating learning models must also look at the appropriate material so that learning remains effective and benefits everyone [14], [35].

This research found theoretical and practical implications. Theoretically, ethnoscience learning can influence students to increase their sense of caring for the surrounding environment [31], [36]. Also, the ability to solve problems can influence the mindset of students in responding to problems in everyday life [12], [37]. In this case, there is an appropriate relationship between ethnoscience learning and students' problem-solving ability. The researchers expect the students to improve learning outcomes through ethnoscience learning associated with socio-scientific issues [21], [34]. Practically, this research is used as input for teachers and students to further improve the learning process and the learning achievements that students have achieved by using ethnoscience learning. Learning between students, teachers, and the environment contributes and interacts so that the learning process is not fixated on books and in the classroom [1], [38]. This learning also makes it easier for students to understand their environment and learn culture [35], [37].

The findings indicate an improvement in students' scientific literacy through the utilization of ethnoscience within socio-scientific contexts, aligning with the research conducted by Rubini [39]. Rubini's study underscores the use of socio-scientific issues in problem-based learning as an effective means to enhance scientific literacy. Therefore, this study underscores the importance of integrating real and relevant contexts in science education to enhance students' understanding and skills. While Rubini focused on the use of the global warming issue within a problem-based learning context, this research takes a step further by integrating ethnoscience, providing a richer local cultural context. These results affirm that students not only acquire scientific knowledge but also develop a deeper understanding of the social and cultural contexts of the scientific issues they learn.

This research offers significant strength in its holistic approach to science education by integrating ethnoscience and socio-scientific issues, enabling students to comprehend and apply scientific knowledge in broader and more relevant contexts. This integration not only enhances student engagement through cultural relevance but also supports the development of critical thinking and problem-solving skills, which are highly valuable in 21st-century education. However, this research faces limitations, including potential constraints on sample size and geographical scope, which may affect the generalizability of its findings. Additionally, this study does not fully explore the long-term impacts of ethnoscience's usage in education, knowledge understanding retention, and application in the long run.

From a scholarly contribution perspective, this research enriches the literature by emphasizing the importance of context in science education and demonstrating how the integration of ethnoscience can make science curricula more relevant and engaging for students from diverse backgrounds. It also offers an innovative learning model that can enhance scientific literacy and student engagement, indicating the potential for this approach to be applied or adapted in various educational contexts. Thus, this research not only provides new insights into contextual science learning but also encourages the development of learning strategies that can empower students to tackle complex real-world problems.

4. CONCLUSION

Based on the analysis, the implementation of ethnoscientific learning related to socio-scientific issues has a significant impact on student learning outcomes. Through this approach, students demonstrate increased activity and engagement in learning, utilizing their immediate environment directly and enriching their learning experiences far beyond textbook material. This learning not only enhances students' understanding of environmental issues but also develops their skills in solving real-world problems, which can be directly applied in everyday life. Pretest and posttest results indicate a significant improvement in students' understanding and skills, confirming the effectiveness of ethnoscientific learning integrated with social issues in enhancing scientific and ecological literacy.

AUTHOR CONTRIBUTION STATEMENT

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

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