



## Ethnoscience-Based E-Modules in Improving Natural Science Learning Outcomes in Junior High School

Enni Maria<sup>1\*</sup>, Nyoto Suseno<sup>2</sup>, Friska Octavia Rosa<sup>3</sup>, Dasrieny Pratiwi<sup>4</sup>

1-4 Universitas Muhammadiyah Metro, Indonesia

✉ \* [ennimaria188@gmail.com](mailto:ennimaria188@gmail.com)

Article Info	Abstract
<p><b>Keywords:</b> Ethnoscience-Based E-module; Science Learning; Educational Technology; Junior High School</p> <hr/> <p><b>Received:</b> 11/03/2026 <b>Revised:</b> 16/04/2026 <b>Accepted:</b> 11/05/2026</p>	<p><b>Background:</b> This study aims to evaluate the effectiveness of ethnoscience-based e-modules in improving Natural Sciences (IPA) learning outcomes at the junior high school level.</p> <p><b>Methods:</b> The research design used was a quasi-experiment with pretest-posttest, involving two groups, namely the experimental group using ethnoscience-based e-modules and the control group using conventional learning. The research sample consisted of 60 students selected using purposive sampling. Data was collected through pretest and posttest tests that measured students' science learning outcomes before and after treatment. The data were analyzed using a t-test to test differences between groups, and an N-gain calculation to measure the rate of improvement in learning outcomes.</p> <p><b>Results:</b> The results showed that the experimental group experienced a significant increase in science learning outcomes, with an average N-gain value of 74.79%, while the control group only reached 45.92%. The t-test showed a significant difference between the two groups (<math>p &lt; 0.05</math>).</p> <p><b>Conclusion:</b> The implications of this study show that ethnoscience-based e-modules can increase students' understanding of science materials, as well as increase students' motivation and involvement in learning. Ethnoscience-based e-modules can be an effective alternative in science learning in junior high school.</p>

## INTRODUCTION

Natural Science Education (IPA) is one of the important components of the basic education curriculum that aims to equip students with basic scientific skills and knowledge that will shape critical and analytical thinking (Yusnarti et al., 2022). Science learning is not only important for understanding the world around students, but also for building a strong foundation for students' academic development at the higher education level. At the junior high school (SMP) level, teaching science is often considered a challenge, both for students and teachers (Risamasu et al., 2023). Many students find it difficult to understand abstract and theoretical science concepts, so that learning outcomes are not optimal (Hedayati et al., 2017).

Although the importance of science education in junior high schools is widely recognized, science learning still faces significant obstacles. One of the main problems found in the field is the low interest of students in science lessons (Hedayati et al., 2017; Nurhayati et al., 2022). Many students find science to be boring and difficult to understand, especially because the material is often abstract and far from the students' daily lives (Hakim & Syofyan, 2018; Hedayati et al., 2017). Students have many difficulties in understanding science concepts that are not connected to the student's direct experience leading to a lack of in-depth understanding of the material being taught (Risamasu et al., 2023). It is important to look for solutions that can address these issues, especially by integrating local culture and technology in learning. Ethnoscience that connects science with local culture (Lidi et al., 2022), allows students to study science through a lens that students are familiar with on a daily basis, thus making the material easier to understand and engaging.

A preliminary study conducted at SMP Negeri 01 Abung Tinggi and SMP Negeri 02 Abung Tinggi, North Lampung, revealed several fundamental problems in science (IPA) learning practices. Based on classroom observations and informal interviews with teachers, it was found that the learning process still predominantly relies on conventional methods such as lectures and textbook-centered instruction. As a consequence, students tend to be passive recipients of information, with limited opportunities to actively construct their understanding. Furthermore, most students demonstrated difficulties in comprehending abstract science concepts, particularly in topics related to heat transfer. This difficulty is exacerbated by the lack of contextualization of learning materials with students' daily experiences and local cultural practices. Teachers also reported that existing teaching materials, including printed modules and worksheets, have not yet integrated local wisdom or ethnoscientific elements, resulting in low student engagement and motivation. In addition, the utilization of digital learning media remains suboptimal. Although schools have begun to adopt basic technological tools, the availability of interactive and contextually relevant digital learning resources such as ethnoscience-based e-modules is still very limited. This condition indicates a gap between the potential of educational technology and its actual implementation in classroom practice. These findings confirm that there is an urgent need to develop innovative learning media that not only leverage digital technology but also integrate local cultural knowledge to make science learning more meaningful, engaging, and relevant for students.

The use of educational technology has become one of the effective ways to improve the quality of learning in science lessons (Pitri et al., 2025). E-modules as a form of technology utilization, offer opportunities to provide more flexible and interesting learning materials (Apriansyah et al., 2024). E-modules allow students to learn independently, with materials equipped with multimedia elements that enrich students' learning experience (Sari et al., 2024). Ethnoscience-based e-modules can be a solution to overcome existing problems in science learning, by connecting science materials with local cultural knowledge and practices (Herlinawati & Suhartini, 2025). Using this approach, science concepts are not only taught as theory but are associated with students' daily lives, for example through the introduction of local agricultural systems, the use of natural resources, or natural phenomena. Ethnoscience-based e-modules provide a more contextual learning experience, allowing students to understand and apply natural sciences (Rahayu & Ahied, 2024).

The ethnoscience-based e-module developed in this study differs from conventional learning media in several important aspects. Unlike printed modules or teacher-centered instructional materials that mainly present abstract scientific theories, this e-module integrates local cultural knowledge with interactive digital features such as videos, images, animations, and self-assessment quizzes. The integration of ethnoscience enables students to connect scientific concepts with familiar cultural practices and real-life experiences, thereby reducing the abstractness of science learning. In addition, the e-module supports independent and flexible learning because it can be accessed repeatedly through digital devices, allowing students to learn according to their own pace and needs. Compared to conventional media, this approach not only improves conceptual understanding but also increases student engagement, motivation, and contextual awareness in science learning.

Various previous studies have examined the influence of the use of e-modules on student learning outcomes. Several studies have shown that the use of e-modules can increase student engagement and facilitate students' understanding of subject matter (Delimanugari, 2024; Herlinawati & Suhartini, 2025; Muliana et al., 2025). E-modules that combine multimedia elements and interactivity have been proven to improve information retention and increase students' motivation to learn (Kimianti & Prasetyo, 2019; Kusuma Sari et al., 2025; Pitri et al., 2025). However, despite research on the use of e-modules in education, the incorporation between e-modules and ethnoscience approaches is still very limited. Several studies related to ethnoscience have shown that the integration of local knowledge in science learning can increase students' understanding and interest, but research that combines ethnoscience with technology-based e-modules in junior high schools is still rare. This research aims to fill this gap by examining the use of ethnoscience-based e-modules in science learning in junior high schools.

From the existing literature review, there is a significant gap in research on the use of ethnoscience-based e-modules in science education at the junior high school level (Herlinawati & Suhartini, 2025). Although technology has been shown to be effective in improving learning in many disciplines, and ethnoscience can enrich the learning experience, the integration of the two in e-modules for science learning in junior high schools has not been widely researched. Existing research is largely focused on the application of technology without considering the local cultural context (Apriansyah et al., 2024). This research brings novelty in important aspects. This research combines two very relevant components, namely educational technology and ethnoscience, in the context of science learning in junior high school. The ethnoscience-based e-module in this study was developed using digital authoring technology that integrates multimedia elements such as text, images, videos, and interactive quizzes. This technology enables learning materials to be presented in an interactive and flexible format accessible through computers and mobile devices. The use of multimedia and interactivity supports student-centered learning by enhancing engagement and facilitating a deeper understanding of abstract science concepts through contextual and culturally relevant content. The use of ethnoscience-based e-modules is expected to enrich science learning by associating the material with local culture and knowledge known to students, thereby making learning more relevant and easy to understand (Prihatmojo et al., 2024). This research provides new insights into how technology and local culture can complement each other in improving student learning outcomes (Sari Wiyasa, 2021).

The main objective of this study is to evaluate the effectiveness of the use of ethnoscience-based e-modules in science learning, as well as to provide empirical evidence supporting the use of this approach in education in Indonesia. This study aims to identify whether e-modules that integrate local culture in science learning can significantly improve students' understanding compared to conventional learning methods. In addition, the results of this study are expected to provide practical recommendations for the development of a more contextual and culture-based curriculum, which can be applied in schools in Indonesia to improve the quality of science education at the junior high school level.

## METHODS

### Design

This study uses a quasi-experimental design with a pretest-posttest design involving two groups, namely the experimental group and the control group. The experimental group was given treatment in the form of learning using ethnoscience-based e-modules, while the control group followed learning with conventional methods. The conventional learning method used in the control group refers to teacher-centered instruction aligned with general practices in the national curriculum, such as lectures and guided discussions. However, it does not specifically implement innovative learning models recommended in the Kurikulum Merdeka, such as project-based or inquiry-based learning. Using this design, researchers were able to measure differences in learning outcomes between the two groups before and after the intervention. The pretest is given before the treatment to measure the student's initial knowledge of the material to be taught, while the posttest is given after the treatment to determine the improvement of student understanding.

### Population and Sample

The population in this study is all grade VII students in junior high schools SMP 01 Negeri Abung Tinggi and SMP Negeri 02 Abung Tinggi in region North Lampung and are studying Natural Sciences (IPA) material. From this population, researchers selected a sample of 60 students divided into two groups, namely 30 students in the experimental group and 30 students in the control group. The sample was drawn from two different schools, namely SMP Negeri 01 Abung Tinggi and SMP Negeri 02 Abung Tinggi. Each school contributed one class selected through purposive sampling based on similar academic characteristics. One class was assigned as the experimental group, while the other served as the control group. This grouping was conducted to ensure practical feasibility while maintaining comparability between groups. To ensure the equivalence of initial competencies, a pretest was administered to both groups before the treatment. The results of the pretest were analyzed using an independent samples t-test, which showed no significant difference ( $p > 0.05$ ) between the experimental and control groups. This indicates that both groups had equivalent initial abilities prior to the intervention. These two classes were selected taking into account similar characteristics, especially in terms of initial understanding of science material, which was measured through the results of a pretest conducted before treatment began. In this way, it is expected that both groups have relatively balanced initial conditions, so that the differences in learning outcomes obtained can be attributed to the treatment given.

### Research Procedure

This research was carried out in several structured stages, starting with the provision of pretests to students from both groups, namely experimentation and control. The pretest is carried out to measure students' initial knowledge of the Natural Sciences (IPA) material to be taught. After the pretest was completed, the experimental group and the control group received different treatments. The experimental group followed the learning using ethnoscience-based e-modules, which were designed to integrate science knowledge with the students' local culture. This e-module includes material that is relevant to students' daily lives, namely heat transfer in the coffee processing process.

After the learning period, both groups were given a posttest consisting of items developed based on the same indicators as the pretest, but with different question formulations. This approach was used to measure the same competencies while minimizing potential testing effects. This posttest is given to measure the extent to which students' learning outcomes improve after being given different treatments. A comparison between pretest and posttest results was used to assess the effectiveness of the use of ethnoscience-based e-modules in improving student learning outcomes compared to conventional learning.

## Data Analysis Techniques

This study uses several appropriate statistical analysis techniques to ensure the accuracy and validity of the research results. The first step is the normality test, which is carried out to ensure that the pretest and posttest results are distributed normally. The normality test is performed using the Shapiro-Wilk test (Shapiro & Wilk, 1965), which is important for determining the type of statistical test to be used next. Once the data are declared normal, the next stage is the homogeneity test, which aims to ensure that both groups (experiment and control) have homogeneous variance. The Levene test is used to test for the similarity of variance between the two groups, which is necessary to ensure that the comparison of learning outcomes between groups can be done fairly.

After meeting the assumptions of normality and homogeneity, the next step is to conduct a t-test (Independent Samples t-test) to test the difference in learning outcomes between the experimental group and the control group. This t-test was used to determine if there was a significant difference between the two groups in terms of improved learning outcomes after treatment. In addition, to measure the effectiveness of learning, N-gain calculations were performed. N-gain is a value used to measure the extent to which student learning outcomes have improved in each group. The formula used is:

$$\text{N-gain} = \frac{\text{Posttest} - \text{Pretest}}{\text{Maximum score} - \text{Pretest}} \quad (1)$$

**Table 1.** N-Gain Interpretation Criteria

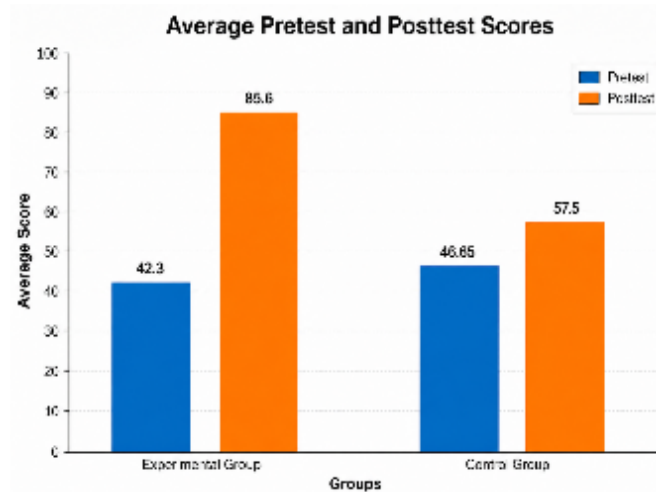
N-Gain Score (g)	Category	Interpretation
$g \geq 0.70$	High	Learning improvement is highly effective
$0.30 \leq g < 0.70$	Medium	Learning improvement is moderately effective
$g < 0.30$	Low	Learning improvement is less effective

The effectiveness of learning was measured using the normalized gain (N-gain) as proposed by (Hake, 1998). In Table 1, the N-gain values are grouped into three levels: high ( $g \geq 0.70$ ), medium ( $0.30 \leq g < 0.70$ ), and low ( $g < 0.30$ ). This categorization was used to interpret the extent of improvement in students' learning outcomes in both the experimental and control groups. All data analysis is carried out using SPSS (Statistical Package for the Social Sciences) software to ensure proper statistical analysis and produce accurate results.

## RESULT

### Data Description

The results showed pretest and posttest data for both groups, namely the experimental group using ethnoscience-based e-modules and the control group using conventional learning methods. Here are the average pretest and posttest scores obtained by both groups.



**Figure 1.** Average Pretest and Posttest Scores

Table 1 presents the data of the experimental group, which uses ethnosience-based e-modules, showing a very significant increase between pretest and posttest scores. The average pretest score for the experimental group was 42.3, which increased to 85.6 on the posttest, resulting in an increase of 43.3 points. Meanwhile, the control group, which used conventional learning methods, saw a smaller improvement, with an average pretest score of 46.65 and a posttest score of 57.5, resulting in an increase of 10.85 points. This shows that although both groups experienced improved learning outcomes, the experimental group using ethnosience-based e-modules obtained greater improvements, indicating that this approach is more effective in improving students' understanding of science material.

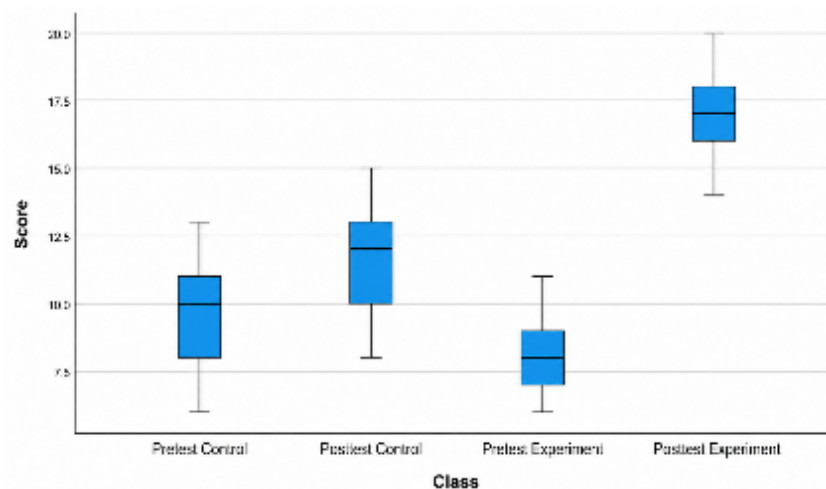
The findings of this study indicate that the ethnosience-based e-module contributes significantly to improving students' science learning outcomes. This improvement is not only reflected in the overall score increase but is also supported by the distinctive advantages of the developed e-module.

The ethnosience-based e-module used in this study possesses several key strengths. First, it integrates local cultural contexts (ethnosience) into abstract scientific concepts, particularly in heat transfer material related to coffee processing practices familiar to students. This contextualization reduces cognitive gaps between theory and real-life experience. Second, the e-module incorporates interactive multimedia elements, including images, videos, and embedded quizzes, which enhance students' engagement and conceptual understanding. Third, it supports self-paced learning, allowing students to revisit materials independently, which is not typically facilitated in conventional learning environments. These features collectively create a more meaningful and student-centered learning experience, contributing to higher learning achievement.

Empirically, the experimental group showed a substantial increase in learning outcomes. The average pretest score increased from 42.3 to 85.6 in the posttest, indicating a gain of 43.3 points. In contrast, the control group only improved from 46.65 to 57.5, with a gain of 10.85 points. This disparity suggests that the ethnosience-based e-module is more effective than conventional teaching methods in facilitating students' understanding.

### Data Normality Test

Normality tests are performed to ensure that the pretest and posttest data are distributed normally, which allows the use of parametric statistical analysis. The normality test was performed using Shapiro-Wilk to test the normality of data distribution in the experimental and control groups. The results of the normality test showed that the significance value was  $>0.05$ , which indicates that the data is distributed normally.

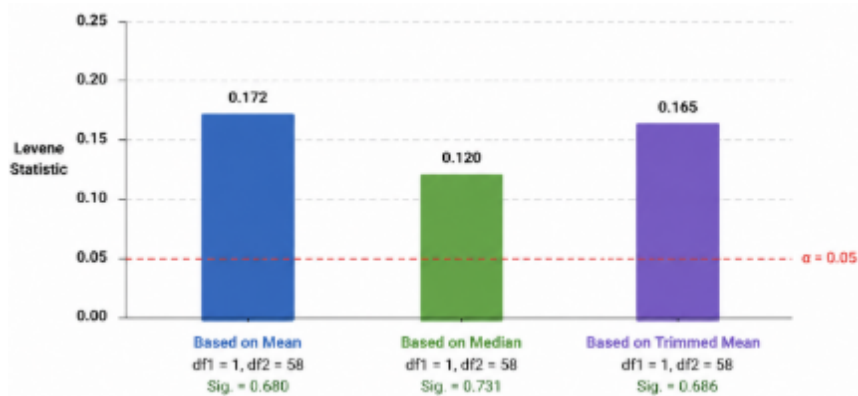


**Figure 2.** Normality Test Results (Shapiro-Wilk)

Based on the results of the Shapiro-Wilk test, the significance value ( $p$ ) was  $>0.05$ , which showed that the pretest and posttest data in both groups (experiment and control) were distributed normally.

### Variance Homogeneity Test

The variance homogeneity test was performed to determine whether the variance of data in the experimental group and the control group was the same or homogeneous. This test uses Levene's Test as one of the prerequisites before performing a parametric test. The results of the analysis showed that the value of the significance on the entire test basis was greater than 0.05, so it can be concluded that the variance of the two groups is homogeneous.



**Figure 3.** Variance Homogeneity Test Results

Based on table 3, the significance value in the test is based on a mean of 0.680, based on a median of 0.731, and based on a trimmed mean of 0.686. All of these values were greater than 0.05, so the data from the experimental group and the control group met the homogeneity assumption. Thus, further analysis using the t-test can be carried out because the condition of similarity of variance between groups has been met.

### T-test (Independent t-test)

The t-test was used to test the significant difference between the posttest scores of the experimental group using ethnoscience-based e-modules and the control group using conventional learning methods. Based on the results of the t-test, there was a significant difference between the two groups in terms of improving science learning outcomes.

Assumption	Levene's Test for Equality of Variances		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
	F	Sig.						Lower	Upper
Equal variances assumed	0.172	—	-11.824	58	0.000 (p < 0.001)	-5.567	0.471	-6.509	-4.625
Equal variances not assumed	—	—	-11.824	57.261	0.000 (p < 0.001)	-5.567	0.471	-6.509	-4.625

Figure 4. Independent t-test

The results of the t-test showed a significant difference between the experimental group and the control group. The t-value for equal variances assumed was -11.824 with a p-value < 0.05 (0.000), indicating that the difference between the two groups was significant. The mean difference between the experimental and control groups was -5,567, which means the experimental group had a much higher posttest score compared to the control group.

### N-Gain Analysis

N-gain analysis was used to measure the rate of improvement in student learning outcomes after treatment. N-gain is calculated to show the effectiveness of learning in improving student understanding. Results of the N-gain calculation for the experimental and control groups:

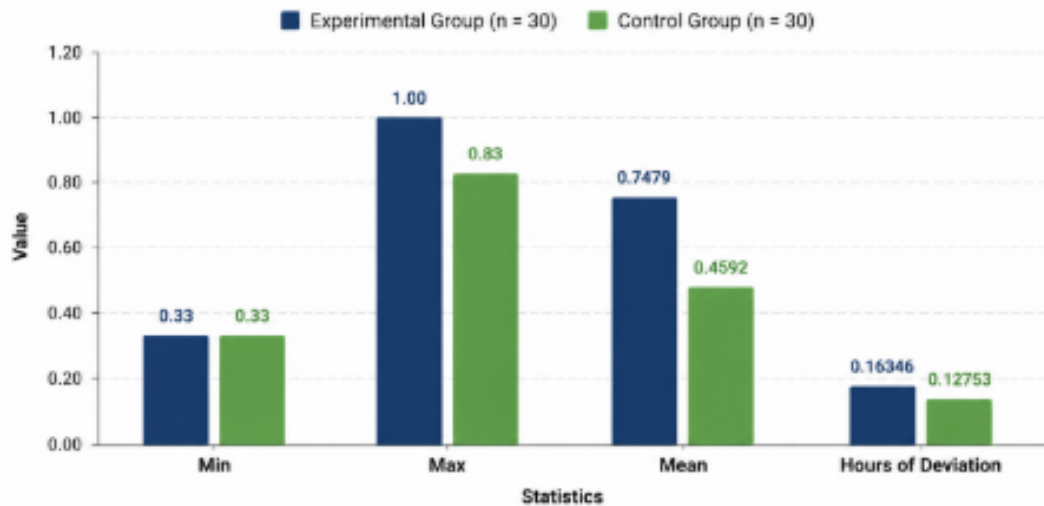


Figure 5. N-Gain calculation

The experimental group using ethnoscience-based e-modules had an average N-gain of 0.7479 (74.79%), indicating a high improvement in science learning outcomes. Compared to the control group that used conventional learning, an average N-gain of 0.4592 (45.92%) was obtained, indicating a moderate improvement. To provide a more detailed understanding of learning improvement, the N-Gain analysis was further examined based on evaluation indicators. The learning outcomes in this study were measured across several cognitive indicators, including: (1) understanding of concepts, (2) application of concepts, and (3) analysis of scientific phenomena. The results show that the improvement in the experimental group occurred consistently across all indicators, with varying degrees of gain:

1. **Conceptual Understanding Indicator:**  
Students demonstrated a high increase, as the e-module presented contextual explanations linked to daily life, enabling easier comprehension of abstract concepts.
2. **Application Indicator:**  
The improvement was also categorized as high, as students were trained through interactive exercises embedded in the e-module, allowing them to apply concepts in real-world scenarios.
3. **Analysis Indicator:**  
Although slightly lower than the other indicators, the increase remained within the medium-to-high category. This indicates that the e-module supports higher-order thinking, although analytical skills still require further reinforcement through extended practice.

Overall, the average N-Gain score for the experimental group reached 0.7479 (high category), while the control group achieved 0.4592 (medium category). This demonstrates that the ethnosience-based e-module not only improves general learning outcomes but also enhances specific cognitive competencies more effectively than conventional learning.

## DISCUSSION

The use of ethnosience-based e-modules significantly improved the science learning outcomes of students in the experimental group. The experimental group, which used ethnosience-based e-modules, saw a much greater improvement, with an average N-gain of 0.7479 (74.79%), compared to the control group which only reached 0.4592 (45.92%). This greater improvement shows that ethnosience-based e-modules make a positive contribution to students' understanding of science material. This is consistent with previous research findings indicating that the integration of technology and local culture in learning can increase students' interest and understanding of the material being taught, as the material is more relevant to students' daily lives (Harianto et al., 2026; Sakti et al., 2024; Sari Wiyasa, 2021).

One of the main reasons why experimental groups have seen a greater increase is the role of ethnosience-based e-modules in connecting science concepts with students' local cultures. By integrating elements of local culture, such as knowledge of local ecosystems or traditional agricultural practices, e-modules make science material easier to understand (Kimianti & Prasetyo, 2019). Ethnosience e-modules improve students' understanding of science material, and create more meaningful learning because students can see the connection between the science taught and culture (Apriansyah et al., 2024; Hariyono et al., 2023). In addition to the cultural context, the use of technology in learning also plays an important role in increasing student interest and engagement. The ethnosience-based e-modules used in this study utilize multimedia elements, such as images, videos, and animations, which make learning more interactive and engaging (Apriansyah et al., 2024; Sudirman et al., 2025). This technology-based learning allows students to learn in a more flexible and fun way, which contributes to improved student understanding.

The ethnosience approach has proven to be an innovative strategy in science learning (Herlinawati & Suhartini, 2025; Sudirman et al., 2025; Widarti et al., 2025). In the experimental group, students feel that learning that links scientific knowledge to the student's local culture not only increases motivation but also enriches students' overall knowledge (Khery et al., 2025). Ethnosience provides an opportunity for students to see that science can not only be found in textbooks but can also be learned through cultural practices and traditions that exist in students' societies (Suprpto et al., 2021; Yuni S et al., 2025). This approach rewards local knowledge that is often overlooked in formal curriculum, increasing students' sense of pride in student culture (Prihatmojo et al., 2026). These findings are empirically supported by the results of this study, where the experimental group demonstrated a significantly higher improvement in learning outcomes compared to the control group, as indicated by the high N-Gain category (0.7479). This suggests that the integration of ethnosience into e-modules not only aligns with theoretical perspectives but also has a measurable impact on enhancing students' conceptual understanding. The contextualization of scientific concepts through local cultural practices in this study appears

to reduce abstraction barriers, thereby facilitating deeper cognitive processing, as also suggested in previous literature. Thus, the present findings reinforce the argument that ethnoscience-based learning is not merely pedagogically relevant, but also empirically effective in improving science learning outcomes.

The use of ethnoscience-based e-modules is more effective in improving student understanding. Conventional learning (Apriansyah et al., 2024; Risamasu et al., 2023). Ethnoscience-based e-modules are enough to provide the interactive and contextual experience needed to make science material more meaningful for students. The results of this study are in line with many previous studies that show that the use of educational technology can improve students' understanding of subject matter (Dewanda et al., 2025; Khotimah et al., 2026). Research by (Sari Wiyasa, 2021; Wu, 2024) shows that e-modules that integrate multimedia elements can improve students' understanding, especially in material that is considered difficult such as science. In addition, ethnoscience-based approaches have been shown to be effective in increasing student engagement with subject matter relevant to students' lives (Fadila et al., 2024). This finding is strongly supported by real classroom phenomena observed during the implementation of the e-module. Students in the experimental group demonstrated more active participation during the learning process, particularly when engaging with ethnoscience-based content related to heat transfer in local coffee processing practices. They were actively involved in observing, discussing, and interpreting scientific concepts based on familiar cultural activities. Furthermore, students showed increased initiative in completing interactive quizzes and revisiting learning materials independently through the e-module, indicating a shift toward self-directed learning behavior.

During classroom interactions, students were also more responsive in asking questions and expressing their ideas compared to those in the control group, who tended to be passive during conventional instruction. This active engagement suggests that the integration of ethnoscience not only enhances conceptual understanding but also fosters meaningful learning experiences rooted in students' socio-cultural context. These observations are in line with (Fadila et al., 2024), who state that ethnoscience-based learning can significantly enhance student involvement by connecting scientific knowledge with real-life cultural practices, thereby making learning more relevant and engaging.

The findings of this study have several important implications for educational practice, especially in science learning in junior high schools. Ethnoscience-based e-modules can be an effective alternative to improving student learning outcomes, especially in contexts that combine scientific knowledge with local culture (Kusuma Sari et al., 2025; Pitri et al., 2025; Winangun et al., 2024). Therefore, education policymakers and schools can consider integrating ethnoscience-based modules into the science curriculum. Technology in learning should not only be limited to conventional media, such as videos and presentations, but can also include interactive modules that are relevant to the student's culture. This approach can strengthen students' sense of pride in student culture, while increasing students' understanding of science. In the long term, the application of ethnoscience-based e-modules can improve the quality of science learning, creating a more meaningful, innovative, and contextual learning experience for students.

## CONCLUSION

Ethnoscience-based e-modules significantly improved Natural Sciences learning outcomes in junior high school students. The experimental group that used ethnoscience-based e-modules experienced a greater improvement in understanding Natural Sciences material compared to the control group that used conventional learning methods. The ethnoscience-based approach successfully connected science to students' local cultures, making learning more relevant and engaging. This strengthens students' understanding of the material being taught and increases students' motivation to learn. Thus, the use of ethnoscience-based e-modules can be an effective

alternative to improving the quality of Natural Sciences learning in junior high school. The findings provide empirical evidence that ethnoscience-based e-modules can be effectively implemented across different school settings with comparable student characteristics. Based on the results of this study, there are important implications for educational practice, especially in science learning in junior high schools. The use of ethnoscience-based e-modules can be an effective alternative to improve student learning outcomes. Learning that integrates scientific knowledge with local cultural wisdom not only enhances students' understanding of science but also strengthens students' connection to their own culture. Therefore, it is recommended that education policymakers and schools consider integrating ethnoscience-based e-modules in their science curriculum. This will provide a more meaningful, innovative, and directly related learning experience to students' daily lives, which can improve the overall quality of education.

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