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The Development of Ethnoscience-Based E-Student Worksheets to Enhance Students Scientific Literacy at Madrasah Ibtidaiyah

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Abstract:
Science literacy is the ability to apply scientific knowledge in daily life, yet students' science literacy in Indonesia remains low. This study aims to develop ethnoscience-based electronic student worksheets (e-LKPD) and evaluate their feasibility, attractiveness, and effectiveness. The research uses the Research and Development (R&D) method with the ASSURE development model. The results show that the e-LKPD received validation from three experts: material experts (95.55%), design experts (91.66%), and learning practitioners (83.00%), all falling into the very valid category. The worksheets were found to be highly attractive, with a score of 85.21%. The N-Gain score was 0.79, indicating high effectiveness. The independent sample T-test revealed a significant difference in science literacy between the experimental and control classes (p = 0.001, less than 0.05). In conclusion, ethnoscience-based e-LKPD effectively enhances students' science literacy, as shown by the improvement from pretest to posttest results.
Keywords: *Development, e-Student Worksheet, Ethnoscience, Scientific Literacy*

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INTRODUCTION

In recent years, scientific literacy has developed rapidly and has been promoted as a mandatory program to be integrated into every educational institution (Chen et al., 2021; Doshi et al., 2024). Scientific literacy addresses the greatest educational challenges in the Society 5.0 era, aiming to produce human resources capable of synergizing with technology, thinking creatively and critically, solving problems, and demonstrating strong character (Herianingtyas, 2022). Furthermore, scientific literacy is defined as the ability to master an understanding of scientific

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concepts, interpret data, solve problems, and draw conclusions that can be implemented in society to create positive environmental impacts (Azmy & Juniarso, 2020; Nuro et al., 2020; Techakosit & Wannapiroon, 2015). Similarly, Bosser, in his article, describes scientific literacy as the cultivation of knowledge, skills, and intellectual attitudes useful for addressing scientific issues in daily life, thereby enhancing its role in preserving nature (Almeida et al., 2023; Bossér, 2024; Oliver & Adkins, 2020).

Based on the above definitions, scientific literacy is essential to be taught from an early age (Yasa et al., 2022). It transforms students' curiosity about how the natural world works into knowledge. Through observation, students formulate questions, seek answers by thinking critically, gather evidence, and draw final conclusions. Students who develop this habit are better prepared for advanced education (Adhari et al., 2024). Indirectly, scientific literacy trains students to explore the unknown through scientific methods and approaches (Sesanti et al., 2022).

As a critical issue in Indonesia's education system, scientific literacy has yet to meet expectations, particularly at the elementary school level. Research by PISA (Programme for International Student Assessment) indicates that Indonesian students' scientific literacy remains at a very low level. Among 81 participating countries, Indonesia ranks 67th. Over the years, the development of students' scientific literacy in Indonesia has shown a tendency to stagnate (Cahya et al., 2022; Kintan Limiansih et al., 2024). The low level of scientific literacy in Indonesia is attributed to various factors, including the use of inappropriate teaching materials, non-contextual content, and students' lack of active participation in the learning process (Atmojo & Kurniawati, 2018; Fuadi et al., 2020; Suparya et al., 2022).

The symptoms of low scientific literacy can be observed in students' inability to provide examples from daily life during lessons, difficulty interpreting data presented in tables, graphs, or diagrams, and a lack of engagement in asking questions. Based on interviews with the head of the madrasa and teachers, these issues were evident among fifth-grade students at Madrasah Ibtidaiyah Miftahul Ulum in Batu City, particularly when studying the topic of sound and its properties. Many students were unable to identify sources of sound in daily life, explain the importance of studying sound, and appeared uninterested in learning science. Furthermore, the head of the madrasa explained that most teachers still rely heavily on textbooks as the primary teaching resource with minimal integration of technology, despite the availability of supporting facilities and infrastructure. However, the quality of teachers at the research site is considered excellent, as their educational background and expertise align with their profession. Given these challenges, there is a need for innovation or breakthroughs to serve as alternative solutions for improving students' scientific literacy, such as e-student worksheets

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based on ethnoscience as teaching materials. This development is also in line with the "Merdeka Curriculum," which positions technology not merely as a supplement but as a core component of the learning process.

The availability of resources such as electricity, projectors, and internet access enable the development of innovative teaching materials like e-student worksheets. The capability of e-student worksheets to combine elements such as audio, animations, text, videos, and active links makes it an interactive and enjoyable teaching tool for students. Additionally, e-student worksheets are designed to align with students' characteristics, addressing the varying abilities of each student (Kamal et al., 2024).

The inclusion of ethnoscience in e-student worksheets can make learning more contextual, as the material and examples are drawn from students' everyday experiences (Lestari & Nabila, 2024; Pertiwi et al., 2021; Rusmansyah et al., 2023). Conceptually, ethnoscience is the integration of science education materials with cultural elements (Elvianasti et al., 2023; Puspita et al., 2022; Thala'at et al., 2022). Similarly, Jumiati describes ethnoscience as a collaboration between science education and culture as the subject of study, allowing students to engage in "learning by doing" rather than "learning by watching or listening" (Jumiati, 2023). In the current context, there is a pressing need to emphasize ethnoscience-based learning. Incorporating local culture into teaching materials can serve as an alternative way to preserve cultural heritage (Jufrida et al., 2024; Pranata, 2022; Restiani et al., 2024). In other words, ethnoscience-based learning helps protect students from the influence of foreign cultures that are gradually eroding local cultural identities (Listiani & Rosita, 2022; Putri et al., 2022).

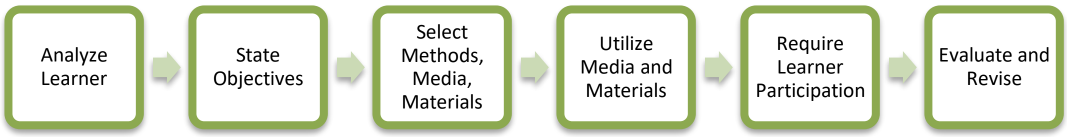
Based on the above explanation, using ethnoscience-based e-student worksheets is an appropriate step to enhance scientific literacy. This is supported by findings from Suryanti et al., (2020), whose research showed that ethnoscience or local wisdom-based learning can increase scientific literacy, with an average n-gain score of 0.5. Similarly, research by Wulan Junita & Yuliani, (2022) reported a significant improvement in scientific literacy, classified as high, with an 85.8% increase. The novelty of this study lies in the cultural elements incorporated into the e-student worksheets, specifically the use of *Banjari* music, an Islamic musical art form, and *Gamelan* music, a traditional musical culture of the Javanese people. Therefore, the aim of this study is to produce new teaching materials that align with students' needs. These materials take the form of ethnoscience-based e-student worksheets to enhance students' scientific literacy. The researcher also hopes that the e-student worksheets, once validated for feasibility, can be adopted on a larger scale by teachers beyond the initial study context.

METHOD

The research method used in this article is Research and Development (R&D). This study aims to produce an innovative product in the form of an ethnoscience-based electronic student worksheet (e-LKPD), which is then tested to evaluate its effectiveness in improving students' scientific literacy. The e-LKPD trial was conducted at Madrasah Ibtidaiyah in Batu City, with the trial subjects consisting of two classes: Class 5 C as the experimental group and Class 5 D as the control group.

The development model employed is the ASSURE model. ASSURE is an acronym representing its development steps: 1) Analyze Learners, 2) State Objectives, 3) Select Methods, Media, and Materials, 4) Utilize Media and Materials, 5) Require Learner Participation, and 6) Evaluate and Revise (Risal et al., 2022).

Figure 1. The ASSURE Development Model Procedure



Madrasah Ibtidaiyah Miftahul Ulum in Batu City has four fifth-grade classes: 5A, 5B, 5C, and 5D. The experimental design used is outlined in the table below

Table 1. Non-Equivalent Control Group Design Research Design

Kelas	*Pretest*	Intervenes	*Posttest*
Experiment (5C)	O_1	X	O_2
Control (5D)	O_3	-	O_4

To collect the required data, this study utilized several data collection instruments, including Questionnaires, consisting of the e-LKPD validation questionnaire, the pretest and posttest instrument validation questionnaire, and the student response questionnaire. Tests, including a pretest to determine the initial level of scientific literacy in both classes and a posttest to measure scientific literacy after the learning process. Scientific Literacy Observation Sheets, used to observe students during the learning process. The pretest and posttest validation questionnaires, e-LKPD validation questionnaires, and student response questionnaires were evaluated by validators using a weighted scoring system based on a Likert scale, The calculation results are then converted into statements and conclusions are drawn based on the criteria table below:

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Table 2. Criteria for the Feasibility/Attractiveness of e-LKPD

No	Persentase	Kriteria	Keterangan
1	85% - 100%	Very Valid/Appealing	Can be used without revision
2	75% - 84%	Valid/Appealing	Can be used without revision
3	65% - 74%	Fairly Valid/Appealing	Can be used with revisions
4	55% - 64%	Less Valid/Appealing	Can be used with revisions
5	0% - 55%	Not Valid/Appealing	Cannot be used

Once the N-gain score has been determined, it is then converted into statements to facilitate decision-making based on Table 3

Table 3. N-gain Score Criteria

No	Persentase	Kriteria
1	$0{,}70 \leq g \leq 1{,}00$	High
2	$0{,}30 \leq g < 0{,}70$	Medium
3	$0{,}00 < g < 0{,}30$	Low
4	$g = 0{,}00$	No Improvement
5	$-1{,}00 \leq g < 0{,}00$	Decline

Finally, the results of the pretest, posttest, and observation scores are accumulated and then analyzed using an independent t-test to determine whether there is a significant difference in scientific literacy between the experimental class, which utilized the e-LKPD, and the control class, which did not. This calculation is conducted with the assistance of IBM SPSS 27 statistical software, using a significant level of 5% or 0.05. The decision is based on the sig. (2-tailed) value: if the value is smaller than the significance level, it indicates a difference between the experimental and control classes.

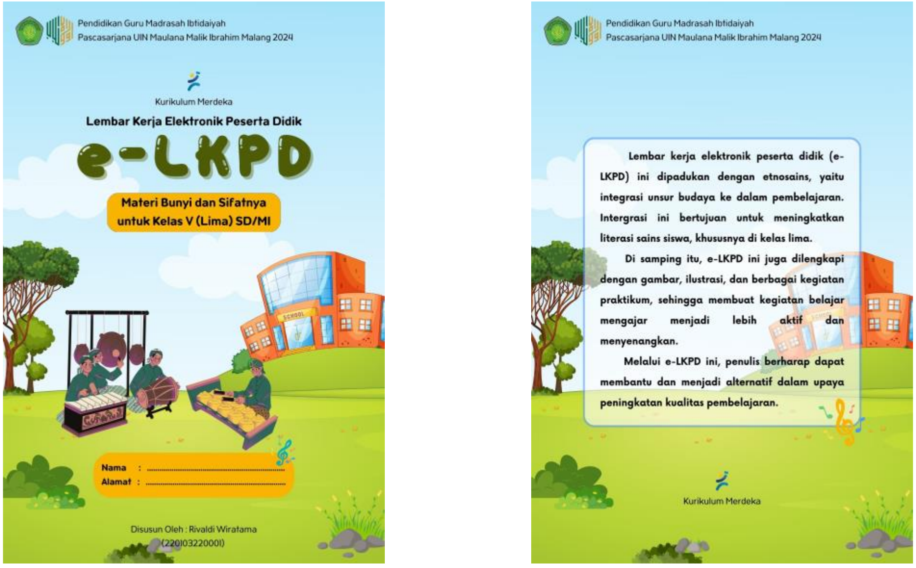
RESULT AND DISCUSSION

The research and development resulted in a product in the form of an ethnoscience-based electronic student worksheet (e-LKPD) with the following specifications:

Table 4. e-LKPD Specifications

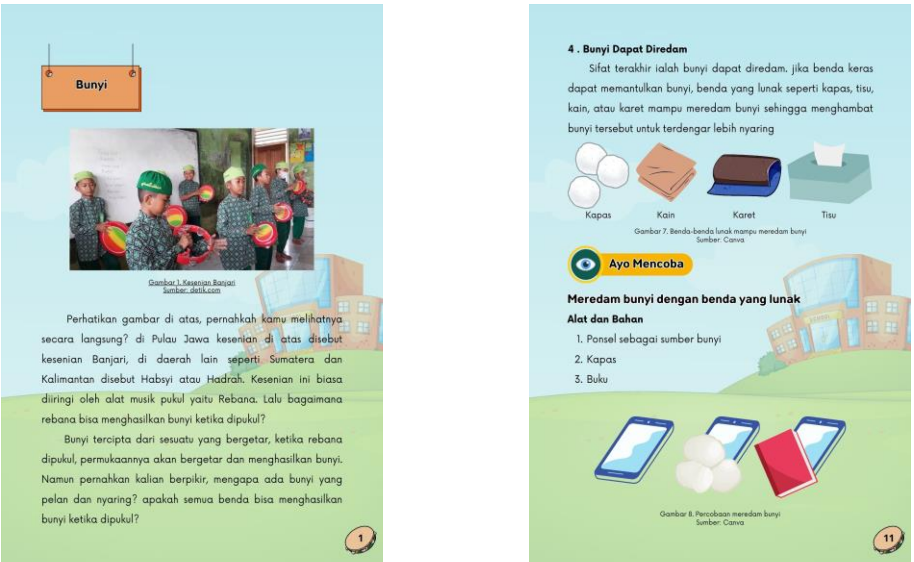
No	Aspect	Description
1	Product	Ethnoscience-Based Electronic Student Worksheet (e-LKPD)
2	Number of Pages	26 Pages
3	Number of Sheets	32 Sheets
4	Size	A4
5	Fonts	1. Opun 2. Playground 3. Now 4. Handelson Four
6	Material	Sound its properties
7	Assesment	1. Kognitif • Multiple Choice • Essay 2. Affective • Observation
8	e-LKPD link	https://heyzine.com/flip-book/0aa2224aa0.html

Figure 2. Front & Back Covers of the e-LKPD



The electronic student worksheet, commonly known as e-LKPD, is an innovation of the conventional printed worksheet that has been transformed into a digital format. The shift from print to digital is considered more efficient due to its ability to simplify and reduce the limitations of space and time in the teaching and learning process. Another advantage of the e-LKPD is its ability to integrate audio, images, animations, videos, text, and more. This capability creates an interactive and engaging learning experience for students (Kamal et al., 2024). The e-LKPD used in this study is equipped with appealing images and illustrations, as well as active links that can be clicked to display YouTube videos.

Figure 3. Images and Illustrations in the e-LKPD



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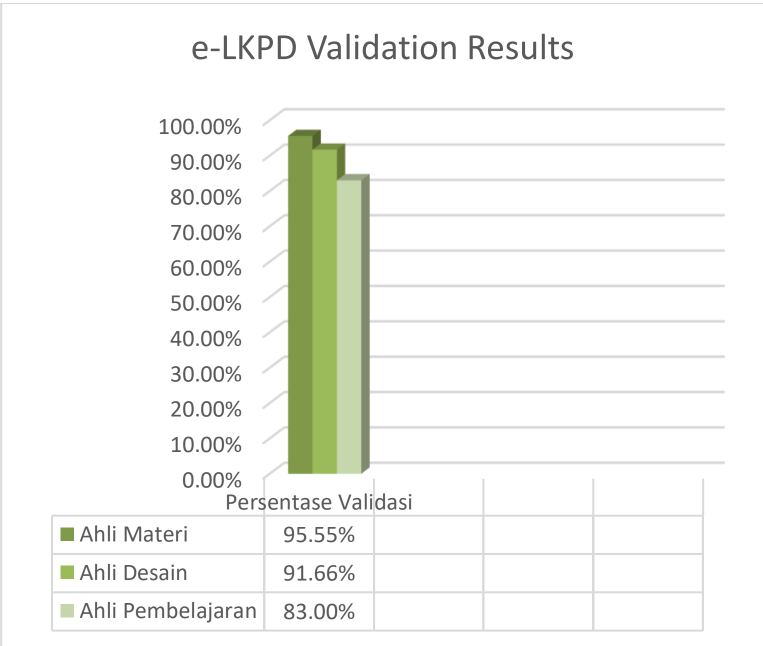
Suryaningsih and Nurlita, in their article, emphasize that the development of teaching materials must align with technological advancements. Therefore, transforming conventional teaching materials and media into digital formats is crucial, considering that students' characteristics and learning styles are heavily influenced by technology (Suryaningsih & Nurlita, 2021). Similarly, Sidiq et al. state that non-print teaching materials, such as e-LKPD, offer greater flexibility and accessibility compared to printed materials. This, in turn, facilitates the teaching and learning process for educators (Sidiq et al., 2024).

The trial of the e-LKPD in learning demonstrated its ability to enable students to learn independently. The role of teachers is not only as facilitators but also as mentors. Additionally, the ethnoscience-based e-LKPD developed in this study allows students to integrate concepts, particularly on the topic of sound and its properties, into their daily lives.

Validity of the Ethnoscience-Based e-LKPD

The validity of a product is a crucial requirement for it to be field-tested. This e-LKPD was validated by three experts: a content expert, a design expert, and a teaching practitioner/expert. The results of the product validation questionnaire analysis showed a score of 95.55% from the content expert, 91.66% from the design expert, and 83.00% from the teaching practitioner. Based on Table 3, the percentage scores from all three validators fall within the "very valid" category and can be used without revision. Below is the validation result graph for the e-LKPD.

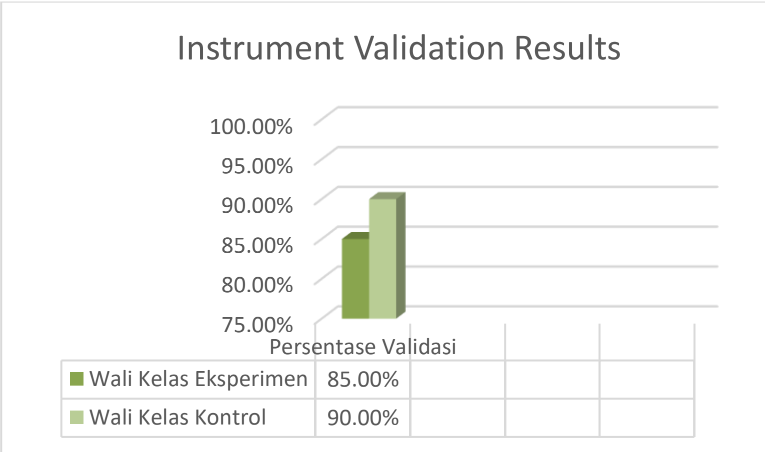
Figure 4. e-LKPD Validity Results Graph



Pretest and Posttest Instrument Validity Test

The purpose of the instrument validity test is to determine whether the instrument can accurately measure the level of scientific literacy (Senjaya, 2020). The instrument validity test is conducted in two ways: first, expert validity (expert judgment), and second, field validity. Two experts validated the instruments: the teacher of the experimental class and the teacher of the control class. The results of the validation were then calculated using a percentage formula. The validity of the instrument is presented in the graph below.

Figure 5. Pretest and Posttest Instrument Validity Results



The instrument was then field-tested. In this case, the pretest was trialed in class 5B with 32 students, and the posttest was trialed in class 5A with 35 students. The next step was to test the validity using Pearson's Correlation Test, assisted by IBM SPSS 27. If the calculated r-value (r_hitung) is greater than the table value (r_tabel), the instrument is considered valid. The results of the instrument validation are presented in Tables 5 and 6.

Table 5. Pretest Question Validity Test Result

No	Question Format	r_{hitung}	r_{tabel}	Description
1	Fill in the Blank	0,391	0,361	Valid
2	Fill in the Blank	0,404	0,361	Valid
3	Fill in the Blank	0,366	0,361	Valid
4	Fill in the Blank	0,652	0,361	Valid
5	Fill in the Blank	0,583	0,361	Valid
6	True/False	0,404	0,361	Valid
7	True/False	0,366	0,361	Valid
8	True/False	0,652	0,361	Valid
9	True/False	0,583	0,361	Valid
10	True/False	0,404	0,361	Valid
11	Essay	0,366	0,361	Valid
12	Essay	0,652	0,361	Valid
13	Essay	0,583	0,361	Valid
14	Essay	0,404	0,361	Valid
15	Essay	0,366	0,361	Valid

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Table 6. Posttest Question Validity Test Result

No	Question Format	r_{hitung}	r_{tabel}	Description
1	Multiple Choice	0,358	0,344	Valid
2	Multiple Choice	0,424	0,344	Valid
3	Multiple Choice	0,501	0,344	Valid
4	Multiple Choice	0,485	0,344	Valid
5	Multiple Choice	0,337	0,344	Valid
6	Multiple Choice	0,489	0,344	Valid
7	Multiple Choice	0,526	0,344	Valid
8	Multiple Choice	0,501	0,344	Valid
9	Multiple Choice	0,358	0,344	Valid
10	Multiple Choice	0,485	0,344	Valid
11	Essay	0,568	0,344	Valid
12	Essay	0,613	0,344	Valid
13	Essay	0,380	0,344	Valid
14	Essay	0,775	0,344	Valid
15	Essay	0,602	0,344	Valid

The calculated r_{values} for both the pretest and posttest items are all greater than the table value (r_{table}). This proves that the items are valid and can be used to assess students' scientific literacy

Instrument Reliability Test

The purpose of the reliability test is to measure the stability and consistency of the results from using the instrument (Permatasari, 2021). In this article, the reliability test uses Cronbach's Alpha method, assisted by IBM SPSS 27. If the Cronbach's Alpha value is greater than 0.6, the instrument is considered reliable. The reliability test data is presented in Table 7 below.

Table 7. Instrument Realibiliy Test Result

No	Question Format	Number of Question	Cronbach's Alpha	Description
1	Fill in the Blank & True/False	10	0,617	Reliabel
2	Essay	5	0,688	Reliabel
3	Multiple Choice	10	0,680	Reliabel
4	Essay	5	0,734	Reliabel

The reliability test results presented in the table above indicate that all Cronbach's Alpha values are greater than 0.6. Therefore, the questions can be considered reliable.

Normality and Homogeneity Tests

Normality and homogeneity tests are prerequisites for conducting parametric statistical analysis. In this study, the normality test utilized the Shapiro-Wilk method, as the sample size in each class was less than 50. If the significance value (sig.) is greater than 0.05, the data can be considered normally distributed.

Table 8. Normality Test Result

No	Class	Number of Student	Sig.	Keterangan
1	Control Pretest	36	0,066	Normally Distributed

2	Control Posttest	36	0,082	Normally Distributed
3	Experiment Pretest	38	0,076	Normally Distributed
4	Experiment Posttest	38	0,103	Normally Distributed

In the table above, all significance (sig.) values are greater than 0.05, indicating that the data is normally distributed. Subsequently, the homogeneity test in this study was conducted using the One-way ANOVA method. If the significance value (sig.) is greater than 0.05, the data is considered homogeneous. The results of the homogeneity test are presented in Table 9.

Table. 9 Homogeneity Test Result

		Levene Statistic	df1	df2	Sig.
Posttest Result	Based on Mean	3,127	1	72	0,081

In the homogeneity test table, the sig value is 0.081, which is greater than 0.05, thus the data can be considered homogeneous.

Hypothesis Testing

Hypothesis testing with an independent sample t-test can only be conducted if the data is normally distributed and homogeneous. This test aims to determine whether there is a significant difference in the level of science literacy between the experimental class, which learns using ethnoscience-based e-LKPD, and the control class, which does not use ethnoscience-based e-LKPD. The decision is based on the sig. (2-tailed) value. If the sig. (2-tailed) value is less than 0.05 (the significance level), it indicates a significant difference between the experimental and control classes. The results of the independent sample t-test, assisted by the IBM SPSS 27 program, are presented in Table 10 below.

Tabel 10. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Hasil	Equal variances assumed	3,127	0,081	-12,586	72	0,001	-19,999	1,589	-23,166	-16,831
	Equal variances not assumed			-12,452	60,257	0,001	-19,999	1,606	-23,211	-16,786

Based on the table above, the sig. (2-tailed) value is 0.001. Compared to the significance level, the sig. (2-tailed) value of 0.001 is less than 0.05. Therefore, it

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can be concluded that there is a significant difference in the level of science literacy between the experimental class, which learns using ethnoscience-based e-LKPD, and the control class, which does not use ethnoscience-based e-LKPD.

Attractiveness of Ethnoscience-Based e-LKPD

The attractiveness of the ethnoscience-based e-LKPD is based on the student response questionnaire. The students who were asked to provide feedback on the e-LKPD were from the experimental class, consisting of 38 students. The results of the student response questionnaire are presented in the graph below.

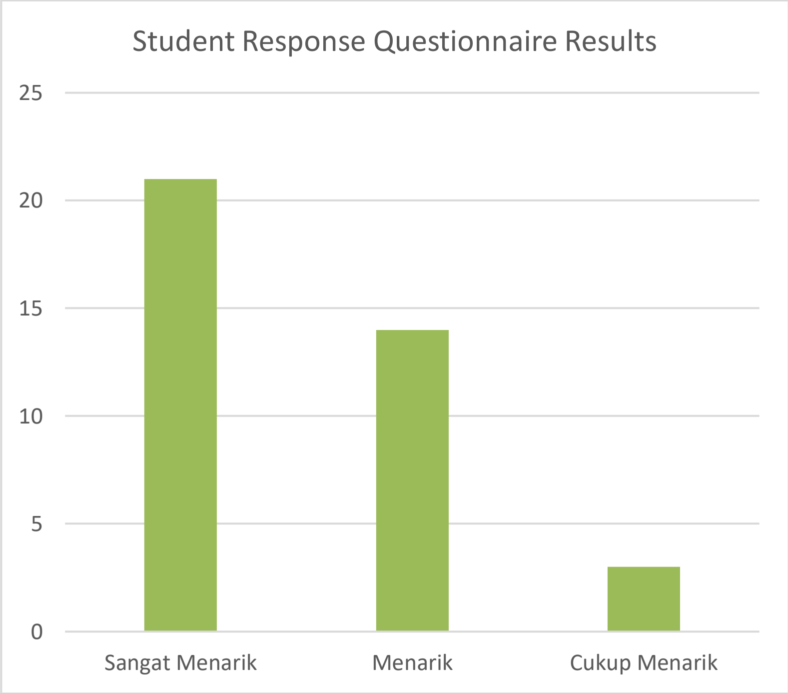

Figure 6. Chart of Student Response Questionnaire Results

Based on the graph, there are three categories: very attractive, attractive, and fairly attractive. Out of 38 students, 21 responded "very attractive," 14 responded "attractive," and 3 responded "fairly attractive." When the average percentage score is calculated, it amounts to 85.21%. Referring to Table 3, this score falls under the "very attractive" category.

Effectiveness of Ethnoscience-Based e-LKPD

The effectiveness of the e-LKPD is calculated using the N-Gain score. In general, N-Gain, or Normalized Gain, is a method used to measure the improvement in performance or learning outcomes by comparing pretest and posttest scores. The N-Gain data is presented in the graph below.

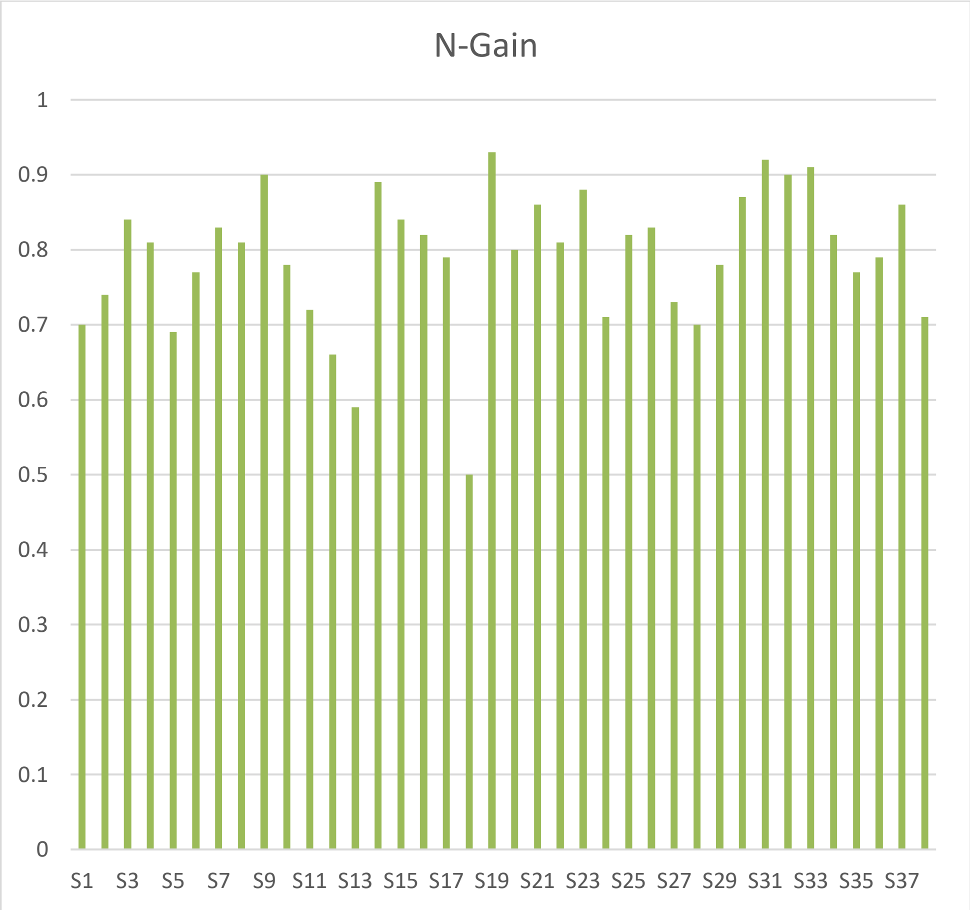

Figure 7. N-Gain Score Chart

Based on the graph, out of 38 students in the experimental class, 7 achieved an N-Gain categorized as moderate (< 0.7), while the remaining 31 students achieved an N-Gain categorized as high. When the average score is calculated, the N-Gain result is 0.79. Referring to Table 4 on N-Gain score criteria, the average score of 0.79 falls into the high category. Therefore, it can be concluded that the ethnoscience-based e-LKPD is effective in improving students' science literacy.

CONCLUSION

Low science literacy can result from various factors, including the use of inappropriate teaching materials and non-contextual learning approaches. In this study, these issues were addressed through the development of ethnoscience-based e-LKPD teaching materials. The flexible and adaptive nature of the e-LKPD allows students to learn independently and at their own pace. The integration of ethnoscience transforms the material into a more contextualized form. By incorporating ethnoscience, students find it easier to grasp the subject matter through cultural elements they frequently encounter. This explanation highlights that ethnoscience-based e-LKPD can effectively address the issue of low science literacy.

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