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The Influence of Biodiversity Teaching Materials Based on Ethnobiological Studies on Students' Scientific Reasoning

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ABSTRACT

The scientific reasoning of MA Negeri 1 Indramayu students is in the moderate category. Biodiversity teaching materials based on ethnobiological studies have never been applied. This study aims to determine the influence of biodiversity teaching materials based on ethnobiological studies on the scientific reasoning of students at MA Negeri 1 Indramayu. The research method used is quantitative. This study's design is a true experimental design with the type of post-test only control design. The population of this study, namely class X MA Negeri 1 Indramayu students consisting of 3 classes with a sample of class X MIPA 1 totaling 30 students as an experimental group and class X MIPA 3 totaling 29 students as a control group. The sampling technique uses random cluster sampling. The instruments used are in the form of tests and questionnaires. Data analysis using normality test, homogeneity test, t-test, and like-t scale. The results showed that the experimental group students' average scientific reasoning was higher than the control group. Based on the hypothesis test value (t_{count} = 3.392 > t_{table} 2.2002), Ho is rejected, and Ha is accepted. There is a significant influence of biodiversity teaching materials based on ethnobiological studies on the scientific reasoning of students in MA Negeri 1 Indramayu. Students' scientific reasoning is in the high category, with a percentage of 66.72%.

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Keywords
Influence, Teaching Materials, Biodiversity, Ethnobiology, Scientific Reasoning

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INTRODUCTION

Scientific reasoning is the ability to think using logic and arrange regularly based on steps to solve a problem. According to Bao et al. (2009), scientific reasoning is the ability to think and reason through investigative activities and experiments and draw conclusions based on facts and arguments to compile and modify a theory about nature and society. Scientific reasoning is essential to practice because it is a foundation for developing other skills, such as critical thinking skills (Handayani et al., 2020). The results of students' scientific reasoning abilities are varied. Students' scientific reasoning at MA Negeri 1 Indramayu is in the medium category (Luzyawati &; Lissa, 2020). For some students, scientific reasoning is in a low category (Viyanti et al., 2021; Rimadani & Diantoro, 2017). In addition, based on data from the Organization for Economic Co-Operation and Development

(OECD) test results based on the Program for International Student Assessment (PISA) in 2009 showed that Indonesian students' low scientific reasoning ranks 60th out of 65 countries, with a score of 385, relatively low compared to the OECD average of 501, especially on a science scale (OECD, 2009). Scientific reasoning is the ability to think systematically and logically to solve problems using the scientific method, including evaluating facts, making predictions and hypotheses, defining and controlling variables, designing and conducting experiments, collecting and analyzing data, and drawing conclusions (Purwana et al., 2016; Koenig et al., 2012; Handayani et al., 2020).

Various factors influence the low scientific reasoning of students. One of the factors causing students' low scientific reasoning is that the teaching materials used do not train students to reason scientifically (Viyanti et al., 2021). Students' scientific reasoning needs to be trained and improved. Rimadani & Diantoro (2017) state that students' scientific reasoning abilities are still lacking, so they must be improved. Some studies show that students' scientific reasoning is still in the low to medium category range. Therefore, learning is needed to improve students' scientific reasoning to reach the highest category of scientific reasoning (Safitri et al., 2018). Based on the results of an interview with one of the biology teachers at MAN 1 Indramayu, teachers have never applied learning using biodiversity teaching materials based on ethnobiology studies or unique teaching materials related to local wisdom, so learning has not emphasized the value of local wisdom. In addition, the teaching materials used have not varied, namely still utilizing existing school facilities in the form of student worksheets (LKS) and package books (for teacher handbooks). Students only use LKS as a learning tool, while textbooks are rarely used because the number is limited.

One solution that can be done to improve students' scientific reasoning is to use teaching materials that contain values or events based on daily life in the surrounding environment, such as teaching materials based on ethnobiology. In this research, the teaching materials used are biodiversity teaching materials based on ethnobiology studies. The teaching book is a biodiversity textbook based on ethnobiology studies of the Losarang Dayak Tribe developed by Luzyawati &; Lissa (2020). The advantages of using teaching materials in the form of biodiversity books based on ethnobiology studies, namely presenting everyday contextual problems that require questions with honest answers. In addition, students can get to know and explore knowledge about local wisdom in their area, so the learning resources used are closer to the student's living environment. Suitable teaching materials are teaching materials that come from the student environment so that the content is adjusted to student needs. Learning will be more meaningful if there is a relationship between the material and the student environment (Monita et al., 2021). This study aims to determine whether or not there is an influence of biodiversity teaching materials based on ethnobiology studies on the scientific reasoning of students at MA Negeri 1 Indramayu.

METHOD

This research was conducted in a quantitative type. The research design used a namely *true experimental design*. The type of design used is a *post-test-only control design*. This research will be carried out in the odd semester of the 2022/2023 Academic Year at Madrasah Aliyah Negeri 1 Indramayu, located on Jl. Soekarno Hatta No. 4 Indramayu, Indramayu Regency, West Java. The

population in this study is all grade X students at MA Negeri 1 Indramayu for the 2022/2023 Academic Year consisting of three classes, namely X MIA 1, X MIA 2, and X MIA 3 totaling 89 students. The sample in this study was class X MIA 1 with 30 students as an experimental class and class X MIA 3 with 29 students as a control class. The sampling technique in this study used *random cluster sampling*. The research instrument used was a description test of 14 questions and questionnaires. Based on ethnobiology studies, the questionnaire determines students' perceptions of biodiversity teaching materials. Student perception was measured using the Likert scale. The indicators of scientific reasoning are presented in Table 1. The categories of students' level of scientific reasoning are presented in Table 2.

Table 1. Number of Question Items Based on Scientific Reasoning Indicators

No.	Indicators of Scientific Reasoning	Number of Question Items
1.	Conservation Reasoning	2
2.	Proportional Reasoning	3
3.	Variable Control	2
4.	Probabilistic Reasoning	2
5.	Correlational Reasoning	3
6.	Hypothetical-Deductive Reasoning	2

Table 2. Student Scientific Reasoning Level Category

Score (%)	Scientific Reasoning Categories
81-100	Very High
61-80	High
41-60	Medium
21-40	Low
0-20	Very Low

(Mariana et al., 2018)

Data collection techniques use test techniques and questionnaire dissemination. Data analysis in this study used parametric statistics using t-tests (two-mean difference tests) and when processing data using IBM SPSS program version 20. The criteria for testing the hypothesis by comparing probability values α= 0.05, namely:

If the value of *Sig. (2-taied)*> 0.05, then variable (X) affects variable (Y).

If the value of *Sig. (2-taied)*< 0.05, then variable (X) does not affect variable (Y).

RESULTS AND DISCUSSION

Scientific reasoning can be defined as the ability to think systematically and logically to solve problems using the scientific method, including evaluating facts, making predictions and hypotheses, defining and controlling variables, designing and conducting experiments, collecting data, analyzing data, and drawing a conclusion (Purwana et al., 2016; Handayani et al., 2020). Students' scientific reasoning can be done through eating learning (Anjani et al., 2020). Ethnobiology-based biodiversity

teaching materials are based on local wisdom (Luzyawati &; Lissa, 2020). This study measures scientific reasoning using biodiversity teaching materials based on ethnobiological studies. The ability of scientific reasoning between the experimental class and the control class was measured using mean values, standard deviations, and parametric statistical tests because, based on normality and homogeneity tests, obtained results that the data were normal and homogeneous. Normality tests were used by IBM SPSS program version 20. The normality test results can be seen in Table 3.

Table 3. Normality Test Result

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	df	Sig.
Penalaran Ilmiah	.069	59	.200*	.974	59	.228
*. A lower bound of the true significance.						
a. Lilliefors Significance Correction						

Based on Table 3, known Sig. values (p) in the *Kolmogorov-Smirnov* test, which is 0.200 (p > 0.05), so that the data can be concluded to be normally distributed. Sig value. (p) in the *Shapiro-Wilk test,* which is 0.228 (p > 0.05), so that the data can be concluded as normally distributed. Meanwhile, the results of the homogeneity test using the help of the IBM SPSS program version 20 can be seen in Table 4.

Tabel 4. Homogeneity Test Result

Test of Homogeneity of Variances			
Scientific Reason			
Levene Statistic	df1	df2	Sig.
3,790	1	57	.057

Based on Table 4. it is known that the value of *Sig*. is 0.057 > 0.05. Since the significant value in the homogeneity output table is more significant than 0.05, it can be concluded that the data variance between the experimental and control groups is equal or homogeneous. The results of parametric statistical tests were carried out using the help of the IBM SPSS program version 20. The results of the hypothesis test can be seen in Table 5.

Table 5. Group Statistics Results

Statistics Group					
	Group	N	Mean	Std. Deviation	Std. Error Mean
Scientific Reasoning	Experiment	30	67.0000	19.73313	3.60276
	Control	29	51.8103	14.09307	2.61702

Table 5 shows that the experimental group that used teaching materials in the form of biodiversity books based on ethnobiology studies amounted to 30 students, with an average result of 67.00. In comparison, the control group that used teaching materials in biology package books amounted to 29 students, with an average result of 51.81. Based on this, there was a difference in average results between the experimental group and the control group. The results of the *independent sample t-test* can be seen in Table 6. Based on Table 6, the Sig value is known in the *output of the Independent Samples T-Test* in the *Equal Variances Assumed section*. (*2-tailed*), which is 0.001 < 0.05, and the calculated t value of the table > t is 3.392 > 2.002. So, it can be

concluded that biodiversity teaching materials affect students' scientific reasoning. The results of the post-tests of scientific reasoning of the control and experimental class are presented in Fig 1.

Table 6. Test Results T / Two Average Difference Test / Independent Sample T-Test

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
Scientific Reasoning	Equal variances assumed	3.790	.057	3.392	57	.001	15.18966	4.47792	6.22277	24.15654
	Equal variances not assumed			3.411	52.530	.001	15.18966	4.45294	6.25633	24.12298

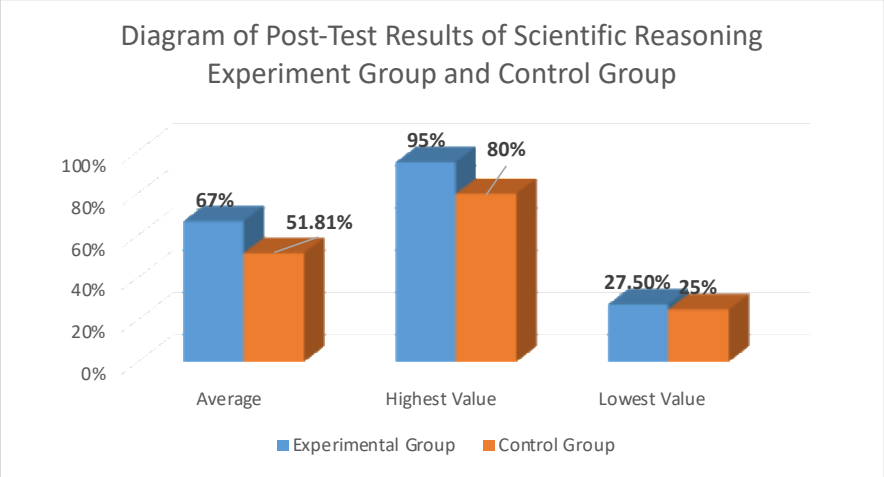

Figure 1. Post-test results diagram of scientific reasoning of experimental group and control group

Based on Figure 1. showed that the average value of the experimental group's *post-test* results was higher than the control group by a difference of 15.19%. The highest value was in the experimental group, while the lowest was in the control group. Students' scientific reasoning consists of six indicators proposed by Lawson (2004). It can be seen from Fig. 1 that there is a difference in the average score of students' scientific reasoning post-test results between the experimental group and the control group. This result is because the experimental group learned using teaching materials like biodiversity books based on ethnobiology studies.

In contrast, the control group learned using teaching materials like biology package books available at school. Students' scientific reasoning can improve through teaching materials based on local wisdom or ethnobiology. Learning based on local wisdom helps students analyze various problems in the surrounding environment, improving scientific reasoning (Priadi et al., 2021).

Learning using biodiversity teaching materials based on ethnobiology studies presents concepts that involve students examining examples of problems that exist in daily life, thus training students to think logically about what they know and improving their scientific reasoning. These results align with Mandella et al. (2021), describing that biology learning that emphasizes logical

thinking and mastery of scientific concepts can affect scientific reasoning abilities. The percentage of students' scientific reasoning categories after learning using biodiversity teaching materials based on ethnobiology studies can be seen in Table 5

Table 7. Percentage of Student Scientific Reasoning Category

No	Indicators of Scientific Reasoning	Experimental Group	
		Value %	Categories
1.	Conservation Reasoning	69.58%	High
2.	Proportional Reasoning	72.45%	High
3.	Variable Control	71.66%	High
4.	Probabilistic Reasoning	66.66%	High
5.	Correlational Reasoning	60.83%	High
6.	Hypothetical-Deductive Reasoning.	59.16%	Medium
Average		66.72%	High

Based on Table 7. The indicators of conservation reasoning, proportional reasoning, variable control, probabilistic reasoning, correlational reasoning, and hypothetical-deductive reasoning are in the high category. However, among the five scientific reasoning indicators, the highest value is on the proportional reasoning indicator, and the lowest is on the correlational reasoning indicator. However, among the six indicators of scientific reasoning, the lowest indicator is hypothetical-deductive reasoning which is in the medium category.

Students' scientific reasoning after learning using teaching materials in the form of biodiversity books based on ethnobiology studies is in the high category, as seen in Table 5. The book presents everyday contextual problems that can arouse students' logical thinking. When students' logical thinking is awakened, it will improve scientific reasoning. In line with Fitriyati & Hidayat's (2017) statement, natural science learning tools in textbooks can improve students' scientific reasoning and critical thinking in schools. The biodiversity book presents cases that require open-ended or varied-answer questions. This book makes students motivated to think scientifically. In line with Kurniawan et al. (2018), questions with honest answers can improve reasoning, problem-solving, and communication skills.

There are six indicators of students' scientific reasoning. Based on Table 7. The percentage of students' scientific reasoning categories of each indicator varies. The highest indicator is in proportional reasoning. Students listen to information related to the material studied, then conduct discussions, questions, and answers related to problems or cases in the book. Students use their thinking skills to elaborate answers based on problems or cases in the textbook so that all activities can be carried out, thus increasing students' scientific reasoning. Textbooks that present cases or problems can encourage student learning activities at school (Nurmita, 2017).

Based on the questionnaire results, student activity indicators (LKS) are in the powerful category. Biodiversity textbooks based on ethnobiology studies present questions related to problems that exist in everyday life to cause critical thinking and scientific reasoning related to the phenomena that occur. Students gain knowledge and experience and sharpen their thinking skills through textbooks. Questions in textbooks can develop students' critical thinking skills (Luzyawati &; Lissa,

2020). Based on the questionnaire results, the listening indicator is in the powerful category. This result occurred because the material presented requires explanation, which makes students hear the material's content in simple language to understand students well. Using biodiversity teaching materials based on ethnobiology studies encourages students to be actively involved, listen and stimulate their curiosity (Luzyawati &; Lissa, 2020).

Indicators of variable control are in the high category. Students explore information through books about flora and fauna exploitation activities with habits carried out by the Losarang Dayak Tribe, who utilize biodiversity. This activity requires students to think logically and systematically about what they learn in books and relate them to problems in everyday life, thus bringing up solutions to solve a problem. Students use their scientific reasoning skills to elaborate solutions to problems. In the learning process, human resources are needed to think and reason scientifically to solve all existing problems (Palenewen &; Hardoko, 2018).

Based on the questionnaire results, students' interest or interest in biodiversity teaching materials based on ethnobiology studies is in a strong category. This result occurred because the teaching materials are unique and based on local wisdom, so it causes interest. The introduction to the biography book presents Indonesia's biodiversity juxtaposed with the Losarang Dayak Tribe, such as origins, founders, and philosophies that can trigger curiosity and stimulate students' interest in learning (Luzyawati &; Lissa, 2020). Based on the questionnaire results, flexible indicators are in a strong category. The material on biodiversity teaching materials based on ethnobiology studies is presented briefly, concisely, and clearly. It contains essential concepts, and the book print is not too thick, so it is light to carry anywhere and be studied anytime without being bound by time. Flexible teaching materials are easy to use (Viyanti et al., 2021).

Conservation reasoning indicators are in the high category. An object that can be seen in reali life and has different characteristics can spur students to think logically about what they see, to improve scientific reasoning skills. Learning related to objects, varied objects, and phenomena in natural or realistic life helps students think systematically using their reasoning power (Haryanti, 2017).

Based on the questionnaire results, students' motivation for biodiversity teaching materials based on ethnobiology studies is in a strong category. This result occurred because the book contains illustrations and pictures encouraging students' desire to learn. These textbook illustrations make understanding the material more accessible, clarify information, and add variety to learning and motivation (Reski et al., 2016). Based on the questionnaire results, the summary indicator is in a strong category. The summary makes learning activities faster and more efficient and helps to understand the material concisely. The summary of the teaching material contains main concepts that make it easier for students to remember, understand and master the material more simply (Masyitah et al., 2021).

. Indicators of probabilistic reasoning are in the high category. Students read books and discuss and conduct investigations related to problems contained in books. Learning that presents concrete problems allows students to be required to think scientifically. Learning in schools that involve scientific investigation can develop students' scientific reasoning abilities (Shofiyah et al., 2018).

Based on the questionnaire results, the reading indicator is in a strong category. This result occurred because the teaching materials presented were interesting. Interesting teaching materials generate interest in reading. Interesting teaching materials cause the desire to read and help students understand the material, and learning does not seem boring (Masyitah, 2021). Based on the questionnaire results, the material presentation indicator is in a strong category. Most students feel that the material presented in biodiversity teaching materials based on ethnobiology studies is complete. The material presented in biodiversity teaching materials based on ethnobiology studies is equipped with pictures, examples, tables, illustrations, biodiversity concepts, and summaries. The complete presentation helps students understand the material (Luzyawati &; Lissa, 2020).

Indicators of correlational reasoning are in the high category. Students are asked to read books, discuss, understand, and identify problems by exploring all their knowledge to describe the interrelationships between observed variables. Students must be encouraged to think openly in problem-solving to develop their knowledge (Haryanti, 2017).

Based on the questionnaire results, students' learning independence towards biodiversity teaching materials based on ethnobiology studies is in a strong category. Student participation in independent learning makes it easier to understand the concept of the material. Using teaching materials in the form of books facilitates students to learn independently (Farida, 2018). Based on the questionnaire results, indicators of language use are in a strong category. This result occurred because the language used in biodiversity books is simple and uses everyday language, so it is easy to understand. The use of language in high school teaching materials is adjusted to students' cognitive development, which is not complicated and not too simple (Luzyawati &; Lissa, 2020).

Indicators of hypothetical-deductive reasoning are in the medium category. Students are allowed to discuss and analyze based on case studies in books. Students are required to find solutions to problems using logical thinking, which allows them to find solutions to problems, thus training them to reason. The ability of scientific reasoning equips students to obtain solutions to solve all problems that occur in everyday life (Yulianti &; Zhafirah, 2020). In addition, according to Han (2013), hypothetical-deductive reasoning is the ability to form hypotheses from general theory to deduction to develop solutions to problems in experiments.

Based on the questionnaire results, the indicator is in a strong category. Students see the pictures presented in biodiversity teaching materials based on ethnobiology studies. Using biodiversity textbooks based on ethnobiology studies of the Losarang Dayak Tribe in learning encourages students to participate, see, read, facilitate finding information, and get meaningful learning experiences (Luzyawati &; Lissa, 2020). Based on the questionnaire results, indicators of material interrelation with life are in a good category. This result is conducted because biodiversity teaching materials present concepts, images, examples, biodiversity use, and problems in daily life. Students will quickly understand the material if the events can be seen directly in real life. Learning resources from the surrounding environment train students to relate material concepts to everyday life. Material from the student's environment makes learning more meaningful, so there is a match between students' knowledge and applications in everyday life (Jannah et al., 2018).

The students' perceptions of biodiversity teaching materials based on ethnobiology studies consist of twelve indicators proposed by (Luzyawati &; Lissa, 2020; Viyanti et al., 2021). The results

of the percentage of student perceptions of biodiversity teaching materials based on ethnobiology studies can be seen in Table 8.

Table 8 Percentage of Student Perception of Biodiversity Teaching Materials Based on Ethnobiology Studies

No.	Indicator	Value %	Categories
1.	Interests/interests	79.66%	Strong
2.	Motivation	78.88%	Strong
3.	Read	77.33%	Strong
4.	Hear	82.66%	Very Strong
5.	See	62.00%	Strong
6.	Presentation of material	74.66%	Strong
7.	Language use	62.66%	Strong
8.	Independence	63.33%	Strong
9.	Flexible	79.33%	Strong
10.	Student activities (LKS)	83.00%	Very Strong
11.	Summary	78.66%	Strong
12.	The interrelation of matter with life	59.33%	Medium
Averge		73.49%	Strong

Based on table 8 shows that the indicators of listening and student activities (LKS) are in the very strong category, while the indicators of interest, motivation, reading, viewing, presentation of material, language use, independence, flexibility, and summary are in the strong category and indicators of material linkage with life are in a good category.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that there is a significant influence of biodiversity teaching materials based on ethnobiology studies on the scientific reasoning of students at MA Negeri 1 Indramayu. Students' scientific reasoning after learning using biodiversity teaching materials based on ethnobiology studies is in the high category based on the average results of scientific reasoning indicators.

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