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Developing Environmental Care Attitudes and Scientific Literacy through Sasi Local Wisdom-Based E-Modules

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ABSTRAK

Belum optimalnya kemampuan literasi sains dan sikap peduli lingkungan yang dimiliki oleh mahasiswa yang nantinya akan berdampak terhadap pelesatraian lingkungan menjadi alasan penelitian ini bertujuan untuk mengkaji dampak E-modul berbasis kearifan lokal "Sasi" terhadap literasi sains dan sikap peduli lingkungan mahasiswa dilakukan. Metode penelitian yang digunakan adalah eksperimen semu dengan rancangan nonequivalent posttest only control group design. Konsentrasi penelitian ini adalah mahasiswa PGSD yang mengambil mata kuliah konsep dasar IPA, dengan total 120 mahasiswa yang terbagi dalam 4 kelas. Pengumpulan data dilakukan melalui tes dan angket. Analisis data meliputi analisis deskriptif dan analisis statistik inferensial. Hasil analisis menunjukkan bahwa pembelajaran dengan e-modul berbasis kearifan lokal sasi efektif dalam mengembangkan literasi sains dan sikap peduli lingkungan, baik secara keseluruhan maupun terpisah, dengan nilai Sig. <0,05. Hal ini menunjukkan bahwa e-modul berbasis kearifan lokal sasi efektif digunakan dalam proses pembelajaran konsep dasar IPA. Penelitian ini memberikan kontribusi penting dalam mendukung implementasi pembelajaran yang lebih holistik dan berkelanjutan dalam pengembangan literasi sains dan kepedulian lingkungan.

ABSTRACT

The lack of scientific literacy skills and environmental care attitudes possessed by students, which will later impact environmental preservation, is why this research aims to examine the impact of local wisdom-based E-module "Sasi" on students' scientific literacy and environmental care attitudes. The research method used was quasi-experimental with a nonequivalent posttest-only control group design. The concentration of this research was PGSD students taking basic science concepts courses, with 120 students divided into four classes. Data collection is done through tests and questionnaires. Data analysis includes descriptive analysis and inferential statistical analysis. The analysis results show that learning with e-modules based on local wisdom sasi is effective in developing scientific literacy and an attitude of caring for the environment, both as a whole and separately, with a value of Sig. <0.05. It shows that e-modules based on local wisdom sasi are effectively used in learning basic science concepts. This research supports holistic and sustainable learning in developing scientific literacy and environmental awareness.

1. INTRODUCTION

Human life's sustainability depends on natural resources in the surrounding environment. Natural resources provide various raw materials that are important to meet human needs in everyday life (Rokhmah & Munir, 2021; Tresnani, 2020). The importance of natural resources for humans requires every human being to instill an attitude of caring for the environment from an early age (Tresnani, 2020; Wardani, 2020). The attitude of caring for the environment is an attitude that is shown by an attitude of always protecting and caring for the environment well, where this attitude of caring for the environment will be able to minimize environmental damage that has occurred, an attitude of caring for the environment can be shown by an attitude of reminding each other not to damage the environment (Indra & Fitria, 2021; Kurniawan & Sudrajat, 2018; Siskayanti & Chastanti, 2022). The importance of caring for the environment requires educators to innovate learning that instills an attitude of caring for the

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environment. Some of the ways that have been done by using the SETS (Science, Environment, Technology, Society) learning model, which is enriched with local culture in science learning, can improve critical thinking skills and an attitude of caring for the environment (Erika & Surya, 2022; Nugroho & Surjono, 2019). Implementing an environmentally friendly school culture can impact students' environmental concerns (Rokhmah & Munir, 2021; Santika et al., 2022). The impact of developing students' skills is discipline, responsibility, and caring for others (Gusmadi & Samsuri, 2020; Ulum, 2018). This description illustrates that innovative learning is one way to increase student's awareness of the environment. In addition to caring for the environment, literacy skills are needed by students today. One of the important literacy skills possessed by students is scientific literacy. With literacy skills, students can produce an idea that begins with a scientific process (Rahmawati et al., 2020; Subayani & Nugroho, 2019). Scientific literacy emphasizes scientific concepts, critical thinking skills, and solving problems encountered in everyday life (Nofiana & Julianto, 2018; Rambe & Khairuna, 2022). An individual who has a deep understanding of science will have a high ability to respond appropriately to the surrounding environment and understand how science, technology, and society interact with one another (Fa'idah et al., 2019; Lestari & Siskandar, 2020; Rambe & Khairuna, 2022). They will have a strong awareness of natural phenomena, be able to critically analyze scientific information, and understand the impact of technology on society and the environment (Fa'idah et al., 2019; Zulfa & Haryanto, 2021). Scientific literacy prepares students with the knowledge, skills, and understanding to deal with environmental problems (Kimianti & Prasetyo, 2019; Zulfa & Haryanto, 2021). With good scientific literacy, students will become individuals aware of environmental issues, able to analyze and solve problems and make sustainable decisions for a better future (Fadilah et al., 2020; Sapitri et al., 2020).

However, in the efforts made by educators to improve environmental care attitudes and scientific literacy skills, these two abilities have yet to be possessed by students optimally or are said to be good. It shows that many students still need to be able to develop their literacy skills properly. It is due to a need for more resources and support (Fadilah et al., 2020). Not all schools or educational institutions have adequate resources to facilitate the development of good scientific literacy and environmental understanding. Limited access to laboratory equipment, relevant learning materials, or training for educators can be an obstacle to student development. Approaches that are too didactic or focus on memorizing facts have yet to be able to encourage students to think critically, analyze information, or relate knowledge to real-world contexts. The results of the initial analysis on second-semester PGSD students support this condition. The initial analysis found that 75% of students were still unable to solve problems related to everyday life. Students' ability still needs to be optimal in connecting the knowledge gained with the problems faced in society. In addition, several students still forget that the waste they produce is thrown away and spit out carelessly. This condition is simple but can impact the surrounding environment if it continues. Given that these students will become prospective elementary school teachers who will set an example for their students, if they do not have scientific literacy skills and care for the environment, the impact will be even greater for environmental destruction.

One of the efforts that can be made to overcome the existing problems is to develop E-modules based on Sasi's local wisdom. This solution was chosen because the e-module is the reading material closest to students. E-module is a learning medium that provides accessibility, interactivity, and flexibility to students in studying the material presented (Puspitasari et al., 2020; Raqzitya et al., 2022). E-modules are presented in the form of electronic documents and can be accessed via electronic devices, thus enabling students to study independently according to the needs, and time they specify (Putrislia & Airlanda, 2021; Sutama et al., 2021; Wulandari et al., 2021). With interactive and multimedia elements, e-modules can enrich students' learning experiences. Another advantage is the ability to enrich and customize e-modules and monitoring and assessment features, making it easier for educators to provide feedback (Alipah et al., 2018; Widiantari et al., 2022). Although challenges such as limited access and technological skills must be considered, e-modules remain an effective tool in education to enhance student learning. Using e-module media in learning will be more effective if developed based on Sasi's local wisdom. Local wisdom "Sasi" is a concept or tradition in local culture that has been proven to support the sustainable management of natural resources (Alvayedo & Erliyana, 2022; Putri et al., 2020). Through size, local communities adopt traditional practices to protect and maintain the environment and ecosystems (Picauly et al., 2022). Sasi has long been considered a tradition or local wisdom with sacred values and has become a habit in people's social life (Lewerissa et al., 2023). This tradition has been passed down from generation to generation and is an integral part of the culture and identity of the local community. Through sasi, the community respects and glorifies the environment and natural resources, which are the source of their life. Implementing sasi involves various rituals, ceremonies, or religious practices carried out regularly and respected by all members of society (Nampasnea & Seipalla, 2023; Tehupeiory, 2021). It reflects an appreciation of the relationship between humans and nature and a

collective responsibility to protect and maintain the environment for the welfare of present and future generations (Kennedy et al., 2019). In the process of community social life, sasi becomes the moral and ethical foundation that regulates actions and relationships between individuals in the context of sustainable natural resource management. The e-module developed by Sasi's local wisdom values will be able to improve scientific literacy skills and students' concern for the environment. Previous studies have revealed that e-modules created using Sigil software are feasible to support thematic learning with local wisdom content (Pratama et al., 2021). Other studies also state that e-modules provide better learning outcomes than teaching materials (Alipah et al., 2018). The results of further research stated that e-modules could improve students' scientific processing abilities (Dari & Nasih, 2020). The study's results stated that PBL-based e-modules could increase scientific literacy (Kimianti & Prasetyo, 2019). The study's results stated that this e-Module increased numeracy literacy and character education through ethnomathematics content (Widiantari et al., 2022). So e-modules will influence learning outcomes, student character, science skills, material understanding, and literacy. In previous studies, no studies specifically discussed the development of environmental care attitudes and scientific literacy through local wisdom-based e-modules. So this research is focused on this study to examine the impact of the local wisdom-based E-module "Sasi" on students' scientific literacy and environmental care attitudes.

2. METHOD

This study uses a quasi-experimental research design. The research design used was quasi-experimental, a nonequivalent posttest-only control group design. In conducting the research, the experimental group was treated with learning using sasi local wisdom-based e-modules. In contrast, the control group was treated with learning methods that did not use sasi local wisdom-based e-modules. The experimental and control groups were given a post-test to measure differences in scientific literacy and environmental care attitudes. The data to be collected in this study include (1) scientific literacy skills (Y1) of students who use local wisdom-based e-module learning, (2) scientific literacy (Y1) of students who use learning methods without local wisdom-based e-modules sasi, (3) environmental care attitude (Y2) students who use e-module learning based on sasi local wisdom, and (4) environmental care attitude (Y2) students who use learning methods without e-module based on sasi local wisdom. This research consisted of three stages: the research preparation stage, the research implementation stage, and the final experiment or research completion stage. The research procedure is described in Table 1.

Table 1. Research activities

No	Research stage	Research activities
1	Research preparation stage	Conducting an initial analysis of the objectives in order to observe learning activities before being given treatment Discuss with teachers regarding scientific literacy and environmental care attitudes possessed by students. Determine the research sample based on the PGSD Department of Musamus University population. Preparation of lesson plans Preparing to learn for the experimental group using learning with e-modules based on Sasi local wisdom. Designing research instruments, namely compiling instruments to be used during the post-test Test the validity of the test instrument to the experts and then improve the test instrument and questionnaire according to the expert's advice.
2	Research implementation stage	Providing treatment to the experimental class in the form of learning with e-modules based on sasi local wisdom The treatment was given eight times in the experimental class.
3	The final stage of the experiment	Giving a final test (post-test) to the experimental class and control class to obtain significant or insignificant data on the use of e-module based on local wisdom sasi learning Finally, an analysis was conducted to process scientific literacy data, students' environmental care attitudes, and hypothesis testing.

The population in this study were all PGSD students taking basic science concepts courses, with 120 students divided into four classes. After testing the equality using One Way-ANOVA (Anava-A) using the SPSS 25.0 for Windows application, a simple random sampling technique was carried out using the

lottery method to select two classes as research samples. The draw results showed that the two classes selected were C and B. Then, another draw was carried out to determine the experimental and control classes. After the drawing process, class B was designated as the experimental group with 30 students.

In contrast, class C was designated as the control group without using sasi local wisdom-based e-modules, with 30 students. In this study, the data collection process used was a test and questionnaire method. The test method is one way that is used to determine the level of individual ability indirectly through giving responses by individuals to several stimuli or questions given. The test method determines students' scientific literacy abilities after being taught by e-modules based on sasi local wisdom. The instrument used in the research test is a description question used to measure the increase in student literacy. Measuring the validity of an instrument can be done through several stages. The steps that can be taken are: 1) making test instrument grids, 2) making questions in the form of descriptions, and 3) consulting the grids. The designed test instrument consisted of 10 items, but the test given to students only consisted of 10 questions. The problem grid is described in Table 2.

Table 2. Indicators of scientific literacy

No	Indicator	CPMK	Cognitive level					
			C1	C2	C3	C4	C5	C6
1	understanding	Mastering the concept of plant parts and their functions		√				
2	Understanding of the Scientific Method	Mastering the concepts of the respiratory system, circulatory system, nervous system and sensory organs, the digestive system of food and the relationship between food and health, the reproductive system and the stages of human development, and the human excretory system				√		
3	Use of Evidence and Arguments	Mastering the concept of animal body structure and function					√	
4	Critical Thinking Skills	Demonstrate the ability to evaluate natural events and their impact				√		
5	Understanding Contemporary Science Issues	Mastering the concept of biotic and abiotic phenomena and ecosystem components				√		

Meanwhile, care for the environment will be measured by a questionnaire. The questionnaire developed consisted of 20 statements. Which was developed from environmental care indicators. 1) environmental knowledge and 2) pro-environmental behavior, 3) participation in environmental activities, 4) awareness of individual impacts, and 5) understanding of contemporary environmental issues. Of these, five indicators will be developed into 20 statements. Each statement will be given a choice of answers in the form of strongly agree, agree, moderately agree, disagree, and strongly disagree. This study's data collection methods include descriptive analysis and inferential statistical analysis. Descriptive analysis was performed using SPSS 26.0 for Windows software, focusing on post-test data. Some values to look for in statistical analysis include the average (mean), standard deviation, maximum value, and minimum value. Furthermore, inferential analysis was carried out through the MANOVA (Multivariate Analysis of Variance) test for post-test data. Prior to carrying out the MANOVA test, a prerequisite test was also carried out, which included the normality test using the Kolmogorov-Smirnov test, the homogeneity test using Levene Statistics and Box's Test of Equality of Covariance Matrices, as well as the multi correlation test. The MANOVA and prerequisite tests were conducted using SPSS 26.0 for Windows software.

3. RESULT AND DISCUSSION

Result

The results showed increased scientific literacy and an attitude of caring for the environment after students took part in learning with e-modules based on sasi local wisdom. It can be seen from the results of the descriptive analysis that has been done. The research shows significant differences in scientific literacy and environmental care attitudes between students who participate in e-modules based on sasi local wisdom and those who do not. The difference in scientific literacy ability between the two

groups reached 9.34, with the average value of scientific literacy in the experimental group being higher. In addition, there is a 5.13 difference in environmental care attitudes between the two groups, with the average value of environmental care attitudes in the experimental group being higher than the control group. The analysis results also show that the more affected variable is scientific literacy rather than environmental care. In more detail, the results of the descriptive analysis can be seen in Table 3.

Table 3. Results of Descriptive Analysis of Scientific Literacy and Independence

Treatment	Dependent variable	Mean	Standard deviation	Maximum	Minimum	Range
Learning with Sasi local wisdom-based e-modules	Science literacy	82,67	6,35	96,00	70,00	26
	Environmental care attitude	83,73	6,27	96,00	73,00	23
Learning without e-modules based on Sasi's local wisdom	Science literacy	73,33	9,03	85	50	35
	Environmental care attitude	78,60	7,30	89	67	22

This study carried out analysis prerequisite tests, including data distribution normality tests, variance homogeneity tests, multivariate homogeneity tests, and multicollinearity tests. The first prerequisite test performed was the normality test using the Kolmogorov-Smirnov method. The analysis results show that all data come from groups of data with a normal distribution. It can be seen from the value of Sig., which is greater than 0.05. After ensuring that the normality requirements are met, the next prerequisite test is conducted to test homogeneity. In this study, the homogeneity test was carried out through two analyses: the homogeneity of variance test using Levene's Test of Equality and the multivariate homogeneity test using Box's Test of Equality of Covariance Matrics. The results of the data normality test analysis can be seen in Table 4.

Table 4. Results of Normality Analysis

	Treatment	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	df	Sig.
Science literacy	Experiment	0.143	30	0.118	0.958	30	0.281
	Control	0.140	30	0.139	0.922	30	0.030
Environmental care attitude	Experiment	0.152	30	0.075	0.947	30	0.140
	Control	0.156	30	0.062	0.912	30	0.016

The results of the homogeneity analysis carried out show the same meaning. That is, the research data come from homogeneous data groups. It can be seen from the sig. Each test shows a value of more than 0.05. Sig. Value Levene's Test of Equality is 0.06 for scientific literacy, while the Sig. Environmental care attitude of 0.21. Meanwhile, the homogeneity test with the Box's Test of Equality of Covariance Matrices obtained a sig. of 0.20 with an F value of 1.53. The next prerequisite test is the multicollinearity test. The analysis results show that the VIF and tolerance values are close to 1. Thus, the scientific literacy and environmental care attitude variables do not correlate. The prerequisite test for MANOVA analysis has been fulfilled, where the research data obtained are normally distributed and homogeneous, and there is no linear relationship between variables so that hypothesis testing with Manova can be carried out. The results of the complete analysis are described in Table 5 and Table 6.

Table 5. Results of the Manova Test Analysis

	Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	0.996	7167.169[b]	2.000	57.000	0.000
	Wilks' Lambda	0.004	7167.169[b]	2.000	57.000	0.000
	Hotelling's Trace	251.480	7167.169[b]	2.000	57.000	0.000
	Roy's Largest Root	251.480	7167.169[b]	2.000	57.000	0.000
Treatment	Pillai's Trace	0.342	14.784[b]	2.000	57.000	0.000
	Wilks' Lambda	0.658	14.784[b]	2.000	57.000	0.000
	Hotelling's Trace	0.519	14.784[b]	2.000	57.000	0.000
	Roy's Largest Root	0.519	14.784[b]	2.000	57.000	0.000

Table 6. Results of Analysis of Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Science literacy	1306.667[a]	1	1306.667	21.425	0.000
	Environmental care attitude	395.267[b]	1	395.267	8.532	0.005
Intercept	Science literacy	365040.000	1	365040.000	5985.390	0.000
	Environmental care attitude	395281.667	1	395281.667	8532.106	0.000
Treatment	Science literacy	1306.667	1	1306.667	21.425	0.000
	Environmental care attitude	395.267	1	395.267	8.532	0.005
Error	Science literacy	3537.333	58	60.989		
	Environmental care attitude	2687.067	58	46.329		
Total	Science literacy	369884.000	60			
	Environmental care attitude	398364.000	60			
Corrected Total	Science literacy	4844.000	59			
	Environmental care attitude	3082.333	59			

Based on the results of the analysis obtained, several findings. First, the MANOVA results show that the Pilae Trace, Wilks' Lambda Hotelling's Trace, and Roy's Largest Root show that the F coefficient is 7167.169 b with a value of Sig. 0.00. This means there are simultaneous differences in scientific literacy and environmental care attitudes of groups of students taught by learning with e-modules based on local wisdom sasi. Second, the Tests of Between-Subjects Effects analysis results show an F value of 21.425 with Sig. 0.000, which is smaller than 0.05. It shows that there is an influence of learning with local wisdom-based e-modules on scientific literacy. Third, the Tests of Between-Subjects Effects analysis results show an F value of 8.532 with Sig. 0.005, which is smaller than 0.05. It shows that there is an influence of learning with local wisdom-based e-modules on the attitude of caring for the environment of students.

Discussion

The analysis results show that learning with local wisdom-based e-modules effectively develops scientific literacy and environmental care attitudes both as a whole and separately. This success can be obtained through the application of appropriate learning methods and the use of relevant media. In this case, local wisdom-based e-module sasi allows students to study and observe what is happening around them through the material being studied. Using this e-module, students can actively learn science concepts through real experiences and direct observations of their surroundings (Puspitasari et al., 2020; Raqzitya et al., 2022). They can see how the local wisdom of Sasi is applied in preserving the environment and how it can impact everyday life. Through this study, students can broaden their understanding of science concepts and develop science literacy skills involving problem-solving, critical thinking, and in-depth information analysis. In addition, learning with e-modules based on local wisdom sasi also provides space for students to gain a deeper understanding of environmental issues and the importance of preserving natural resources (Alipah et al., 2018; Widiantari et al., 2022). They are invited to realize their responsibility as the younger generation in protecting the environment and taking sustainable actions. Thus, learning with local wisdom-based e-modules provides an interesting and relevant learning experience for students, which can increase their scientific literacy and environmental care attitude. It will make the learning process more meaningful. Learning will give students a good experience and social and emotional development (Bressington et al., 2018; Kostiainen et al., 2018).

Involving local wisdom in the learning process will have a positive influence, where integrating local wisdom in learning allows students to appreciate and understand the values, traditions, and knowledge inherent in their own culture. This statement is by several research results, including using the VCT model based on Madura local wisdom on student learning outcomes (Suttrisno et al., 2020). With the right harvest time, integrating local wisdom such as sasi can help students learn how to protect the environment, including forests, seas, and other natural resources (Kennedy et al., 2019; Picauly et al., 2022). Through the implementation of Sasi, students are taught about the importance of maintaining the balance of the ecosystem and preventing environmental damage that can occur due to over-exploitation.

By understanding and respecting the principles of Sasi, students will learn about the sustainable management of natural resources and the importance of maintaining environmental sustainability for long-term prosperity (Nampasnea & Seipalla, 2023; Tehupeiory, 2021). By introducing local wisdom, such as sasi, students will increase their awareness and understanding of their responsibilities in protecting and calming the surrounding environment. The learning module's local wisdom will help students understand the environment and the natural surroundings. Learning that involves nature will increase students' interest because they feel that what they learn can apply in the future (Putrislia & Airlanda, 2021; Sutama et al., 2021; Wulandari et al., 2021). It will impact students' understanding of science, their ability to solve problems using scientific methods, critical thinking skills, and understanding of contemporary issues, including the issue of climate change caused by forest destruction. All of these abilities are included in the category of scientific literacy. Students who have scientific literacy skills will be able to produce ideas based on scientific processes. This scientific literacy deals with scientific concepts, critical thinking, and problem-solving skills that can be applied in everyday life (Rambe & Khairuna, 2022). Individuals who deeply understand science can respond appropriately to their surroundings and understand the interactions between science, technology, and society (Kimianti & Prasetyo, 2019; Zulfa & Haryanto, 2021). They also have a strong awareness of natural phenomena, the ability to critically analyze scientific information, and an understanding of the impact of technology on society and the environment (Fa'idah et al., 2019; Zulfa & Haryanto, 2021). Scientific literacy prepares students with the knowledge, skills, and understanding to deal with environmental problems (Nofiana & Julianto, 2018; Rambe & Khairuna, 2022). By having good scientific literacy, students will become individuals who are aware of environmental issues, have analytical and problem-solving skills, and can make sustainable decisions for a better future (Fadilah et al., 2020; Kimianti & Prasetyo, 2019; Zulfa & Haryanto, 2021). Therefore, educators need to identify the best solutions to overcome problems students may face in their literacy skills.

The results obtained in this study align with previous research results, which also revealed that e-modules created using the Sigil software are very feasible to support thematic learning with local wisdom content (Pratama et al., 2021). Other studies also state that e-modules provide better learning outcomes than teaching materials (Alipah et al., 2018). The results of further research stated that e-modules could improve students' scientific processing abilities (Dari & Nasih, 2020). The study's results stated that PBL-based e-modules could increase scientific literacy (Kimianti & Prasetyo, 2019). The study's results stated that this e-Module increased numeracy literacy and character education through ethnomathematics content (Widiantari et al., 2022). Based on these results, e-modules will influence learning outcomes, student character, science skills, material understanding, and literacy.

4. CONCLUSION

Based on the data analysis and discussion results, learning with sasi local wisdom-based e-modules can potentially increase students' scientific literacy and environmental care attitude. The results of this study make an important contribution to supporting the implementation of more holistic and sustainable learning in the context of developing scientific literacy and environmental awareness.

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