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Enhancing Observation and Questioning Skills in Rural Science Education

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Abstract: This study aims to determine the influence of enhancing observation and questioning skills on learning outcomes, and to describe the relationship between these skills and science learning outcomes. The study included 86 fifth-grade students from four distinct rural elementary schools. Participants were divided into control and experimental groups. The collected data encompassed learning outcomes and metrics on observation and questioning skills. The impact of advancing observation and questioning skills was evaluated using an independent sample t-test at a 5% significance level. The Pearson correlation was employed to discern the relationship between these skills and learning outcomes. Results indicated that fostering observation and questioning skills significantly affects students' cognitive learning achievements. Additionally, both skills were found to have a positive and significant association with learning outcomes. While observation skills displayed a moderate relationship, questioning skills showcased a stronger correlation. Thus, enhancing these skills in science education is crucial for optimizing student learning outcomes.

Keywords: Observing Skills; Questioning skills; Rural Area; Science

Introduction

One of the main goals in science education at the elementary school level is to enhance science process skills (SPS). SPS is crucial as it enables students to acquire observation and questioning skills necessary for investigating natural phenomena, solving problems, and making decisions. Questioning and observing are two elementary components of SPS. According to Padilla et al. (1983), observing is the ability to receive and interpret information from external sources. This skill lays the foundation for other science process skills such as measuring, predicting, communicating, formulating questions, and concluding (Rezba et al., 2003). Moreover, accurate observation can lead to precise questions, predictions based on data, and correct conclusions (Padilla et al., 1983). In science education, observing means meticulously using the five senses to gather information. Students utilizing this skill in science learning will record everything they see, hear, and feel about the phenomena they observe (Rezba et al., 2003; Senisum et al., 2022). Observed information will be connected with other understood information, be it concepts, facts, or prior experiences, when used with cognitive abilities. Observing phenomena is not the same as questioning. In science education, questions stemming from deep observation of a phenomenon promote logical thinking (Ambross et al., 2014; Padilla et al., 1983). Early scientists used questioning skills as a foundation to initiate inquiries (Herranen & Aksela, 2019).

Teachers can assist students in critical thinking by posing questions (Kaya & Temiz, 2018; Senisum et al., 2022). Questions posed by the teacher can help activate their cognitive abilities to recall what they know and link it to their prior knowledge. This enables the teacher to enhance the students' understanding of the subject matter. Conversely, to improve students' communication abilities, questions can aid them in conveying concepts and messages to instructors or other students (Eliasson et al., 2017). Since students are the main actors in learning and teachers function as

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facilitators, students' questions must be addressed. Teachers are responsible for training students to pose questions that begin with observations of crucial science phenomena. This not only promotes various competencies in the learning process but also supports the realization of graduate competencies at the elementary education level, wherein students demonstrate the ability to question, understand, and convey information (Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia Number 5 Year 2022 on Graduate Competency Standards for Early Childhood Education, Elementary Education, and Secondary Education, 2022).

Formation of science process skills, such as observing and questioning, can succeed with the support of learning media. Learning models are also crucial (Putra et al., 2016). The natural rural environment can be used as a medium to support science education, especially since the observed objects are intertwined with the student's experiences. Direct observation in nature leaves a more significant impression on building science concepts (Choirunnisa et al., 2018). Learning science directly in nature also enhances students' awareness of the importance of care and love. This is superior to learning by reading textbooks or watching animated videos (Zakirman et al., 2022). For elementary school students, learning directly from the natural environment means they deal with real objects and phenomena. This aligns with Piaget's cognitive development theory (Zhang, 2022), which states that the cognitive development of students aged seven to eight years is at the concrete operational stage, making it crucial to learn science by directly engaging with nature. Critical thinking abilities can be enhanced by improving questioning skills that begin with observing real objects, according to other researchers (Herranen & Aksela, 2019; Kaya & Temiz, 2018).

Although much literature emphasizes the importance of SPS (Padilla et al., 1983; Rezba et al., 2003), the reality on the ground, especially in elementary schools in Manggarai Regency, seems different. There appears to be a more specific issue in implementing SPS. Data suggests that most elementary students in Langke Rembong District struggle with using observation and questioning skills. Many elementary school science lessons remain theoretical and rely on textbooks. This can result in students being less actively involved in the science research process, which in turn can diminish the quality of their education (Safira et al., 2020). Not many studies have investigated the use of media in supporting SPS learning, especially in elementary schools across Langke Rembong District, where the natural rural environment is an integral part of students' daily lives. Such an environment can provide a rich and authentic learning experience, allowing students to gain a deeper understanding of the environment and enhance their naturalistic intelligence (Hartika et al., 2019).

Considering this situation, this research aims to bridge the gap by focusing on the development of SPS in a rural environment, particularly in Manggarai Regency. This study hopes to offer fresh insights and practical suggestions to improve the quality of science education in elementary schools by using a local context and integrating it with science learning principles. Science process skills (SPS) have been the subject of numerous researches. However, the elementary focus of this research is how SPS is used in conventional classroom environments. Yet, studies on how to use the rural environment as a learning resource for SPS development are still scarce, especially in the context of Indonesian education and more specifically in Langke Rembong District.

This study aims to enhance students' science process abilities through the use of the rural environment, with a specific emphasis on observation and questioning skills. In Manggarai Regency, the natural rural environment has diversity and uniqueness that allow various science theories to be tested. Therefore, we must understand how this environment can be best utilized for learning.

Method

This research design aims to 1) develop aspects of observation and questioning skills in elementary school science learning, 2) apply the aspects of observing and questioning in learning by utilizing the natural environment around as a learning resource, and 3) analyze the relationship between students' observation and questioning skills with science learning outcomes. In line with these objectives, this study employs the nonequivalent pretest-posttest control group design (Creswell & Creswell, 2018). The subjects of the study were fifth-grade elementary school students whose schools are located in rural areas and are partner schools with the campus for implementing internships for students in the Elementary School Teacher Education program. This research involved four elementary schools, each school having one grade 5 study group. All four schools have the same accreditation value based on the latest accreditation assessment, indicating similarities across the eight national education standards. The four study groups were then randomly grouped; one class was designated as the experimental class, and another as the control class.

The learning process in the selected experimental class implemented a natural environmental approach, utilizing nature as a science learning medium. The

Lesson Plan and Student Worksheets were designed following this natural environmental approach, emphasizing activities that develop observation and questioning skills. Students were asked to observe objects or phenomena and then record their observations on specific sections of the worksheet. Based on these observations, students formulated and wrote questions on the worksheet. Meanwhile, the control class received no special treatment other than collecting post- and pre-research learning outcome data. To measure learning outcomes, the prepared instrument was a multiple-choice test, where each question was scored 1 for correct and 0 for incorrect answers. To measure the ability to observe and ask, a rubric was used: 3 for accurate observations according to the observed object, 2 for mostly correct observations, 1 for few correct observations, and 0 for no observation. Questioning ability was assessed with a rubric: 3 if the question posed was critical and in line with the observed object, 2 if the question was critical but not relevant, 1 if the question was not critical, and 0 for no questions posed.

The data collected in this study consists of two types. The first data is learning outcomes before and after treatment in all four study groups. The second is data on students' observation and questioning abilities, which was collected only in the experimental class. This second type of data was gathered in every learning activity that required students to observe objects or natural phenomena relevant to the lesson theme, resulting in average scores.

Data analysis was conducted to answer the two research problems. Data on learning outcomes, observation skills, and questioning skills were analyzed using descriptive and inferential statistics. Descriptive statistics were used to calculate the mean pretest and post-test scores, standard deviation, and determine the highest and lowest averages. Inferential statistics were employed to determine data normality, homogeneity, and variance. The one-sample Kolmogorov-Smirnov formula was used for normality testing and Levene's Test of Equality of Error Variances for homogeneity testing. To determine the effect of developing observation and questioning skills on students' learning outcomes, post-test data from the experimental and control classes were analyzed using the independent t-test with a 5% significance level. The hypothesis for the first issue is: H0: There is no difference in average student learning outcomes between the experimental and control groups. Ha: There is a difference in average student learning outcomes between the experimental and control groups.

Meanwhile, to answer the second research question on whether there is a significant correlation between the two skills and learning outcomes, Pearson correlation analysis was used. All data analyses utilized SPSS 26.0 for Windows.

Results and Discussion

Result

Learning Outcome Data

The learning outcome data analyzed in this study is data taken before starting the treatment (pretest) and after the treatment (posttest). The descriptive analysis results of the learning outcome data are displayed in Table 1.

Table 1. Descriptive Analysis Results of Pretest and Posttest Data.

Class	N	Pretest Values				Posttest Values			
		Mean	Deviation Standard	Max.	Min.	Mean	Deviation Standard	Max.	Min.
Control	44	42.55	15.13	76.00	18.00	67.77	10.52	90.00	60.00
Experiment	42	41.19	14.28	70.00	18.00	81.52	8.43	94.00	64.00

From Table 1, it can be seen that both student groups experienced an improvement in learning outcomes. This improvement is observed from the mean value of each group. The group that showed a larger increase was found in the treatment class where students developed their observational and questioning skills in learning. To address the first research problem, the results of the t-test analysis for post-test data, preceded by prerequisite tests (normality and homogeneity), are presented in Table 2.

Based on the data presented in Table 2, the significance value (ρ-value) of the Kolmogorov-Smirnov and Shapiro-Wilk tests for the treatment class and control class is greater than the α value = 0.05 ($p > 0.05$). Thus, it is concluded that the students' learning outcome data in both groups are normally distributed. Additionally, to determine the homogeneity of the data, the results of the analysis with the Levene Test are shown in the following Table 3. Table 3 also displays the results of the Independent Sample Test to address the first research problem.

Table 2. Results of the Data Normality Test

Class	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experiment	0.147	42	0.202	0.928	42	0.191
Control	0.111	44	0.200	0.964	44	0.182

Table 3. Results of the Independent Samples Test Analysis.

Learning Outcomes	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
Equal variances assumed	2.64	0.11	6.67	84	0.00	13.75	2.06	9.65	17.85
Equal variances not assumed			6.70	81.57	0.00	13.75	2.05	9.67	17.83

The data analysis results shown in Table 3 indicate that the significance value from the Levene Test is 0.108. This value is greater than α = 0.05 (p > 0.05). Thus, the learning outcome data from the two student groups have a homogenous variance.

Furthermore, the data in Table 3 is also presented to answer the hypothesis of the first research problem, which is about how the empowerment of observation and questioning skills affects learning outcomes. The significance value obtained from the t-test analysis is 0.000. Since this value is smaller than 0.05, H0 is rejected and Ha is accepted, meaning there is a significant difference between the learning outcomes of the treatment group and the control group. Therefore, it is concluded that the development of observation and questioning skills can influence different learning outcomes in student groups.

Data on Observation and Questioning Skills

The data on observation and questioning skills in this study was obtained from 42 students in the experimental group. Data collection for observation and questioning skills was conducted after each learning session. In this case, data was collected five times. Both types of skill data were gathered to address the second research problem, which is whether there is a significant relationship between observation and questioning skills with students' learning outcomes. The results of the descriptive analysis and correlation test are presented in Table 4**.**

Table 4. Correlation Analysis Results

Parameters	Statistic	Observation	Questioning	Learning Outcomes
Observation	Pearson Correlation	1	0.204	0.448**
	Sig. (2-tailed)		0.196	0.003
	N	42	42	42
Questioning	Pearson Correlation	0.204	1	0.648**
	Sig. (2-tailed)	0.196		0.000
	N	42	42	42
Learning Outcomes	Pearson Correlation	0.448**	0.648**	1
	Sig. (2-tailed)	0.003	0.000	
	N	42	42	42

**. Correlation is significant at the 0.01 level (2-tailed).

Discussions

The significance value of observation skills in relation to learning outcomes is 0.003. This significance value is smaller than α = 0.05 (p < 0.05), concluding that there is a correlation between observation skills and learning outcomes. A Pearson correlation value of 0.448 indicates that the correlation between the two is at a moderate level (Sugiyono, 2010). Meanwhile, the significance value between questioning skills and learning outcomes is also smaller than α = 0.05, meaning there's a correlation between them. A Pearson correlation value of 0.648 suggests that questioning skills have a strong relationship with learning outcomes. Both observation and questioning skills have a positive relationship, meaning if the observation and questioning

skills are developed, it will also enhance students' learning outcomes.

The development of observation and questioning skills in elementary school science education influences the enhancement of students' learning outcomes (Farrokhnia et al., 2020; Kawuri et al., 2019; Pherson-Geyser et al., 2020). This is evident from the research data in Table 3, which shows a difference in learning outcomes between students who developed observation and questioning skills and those who did not. Observing and questioning are two types of process skills in science learning. Research data, as in Table 4, also reveals a positive and significant relationship between observation and questioning skills with learning outcomes. This research supports previous studies (Feyzioglu, 2009) which indicated that empowering science process skills in learning enhances students' academic achievements.

Observation is a process where human senses receive information from the environment (Rahman, 2019). Information obtained during observation enters the memory structure in the brain, activating other knowledge related to the observed phenomena. Observation skills are crucial because accurate and detailed observations produce valid information as a basis for decision-making. Haury (2003) mentioned that scientific knowledge, from ancient times to today, starts with observation activities. Observing direct scientific phenomena according to daily life experiences differs from observing the same phenomena through indirect media like pictures or videos. The action to develop observation skills for elementary school students in this study supports Piaget's cognitive development theory, which states that elementary school students should learn directly using concrete learning media. The students' observations of science objects in their environment in this research positively impacted their learning outcomes. Although this research indicates that the relationship between observation skills and learning outcomes is moderate, Sahnaz et al. (2018) suggests that proper observation skills in elementary school students will impact the same skills when they proceed to secondary education. Therefore, (Padilla et al., 1983) states that observation is the most basic scientific skill, supporting thinking ability.

Questioning skills are intertwined with observation skills (Hindman et al., 2020; Larimore, 2020; Sutiani, 2021). New information received through sensory observation and entering the cognitive structure can either align with existing information or conflict with it, causing questions. Naturally, a mismatch between new information and existing information will raise questions. Driven by this cognitive conflict, scientists from the past to the present have used questions as a starting point for various scientific researches. As it relates to information in the cognitive structure, other experts Herranen & Aksela (2019) state that questions depict thinking abilities. Thinking abilities are then categorized into low-level and high-level thinking abilities. High-level thinking means having critical thinking skills. In relation to questions, Herranen & Aksela (2019) and García-Carmona (2019) elaborate that high-level questions are posed by students with high-level thinking abilities, while low-level questions are posed by those with low-level thinking abilities. In this research, although not elaborating in detail students with high and low thinking abilities, in reality, there are students who frequently pose critical questions using "why" and "how". These students are identified as having higher learning outcomes compared to their peers.

The data analysis results in this study reveal that there's a very strong and significant positive correlation between questioning skills and learning outcomes. Meaning, the better the students' questioning ability, the higher their learning outcomes. Another researcher (Kaya & Temiz, 2018) conducted a study on 39 elementary school students and revealed that students' academic achievements increase in line with their ability to pose critical questions. Recent studies in science indicate that students' critical thinking abilities can be developed by honing questioning skills. In science learning, developing questioning skills not only sharpens critical thinking but also enhances communication skills (Azizi & Herman, 2020).

Developing questioning skills, which starts with observing science objects in the school environment (Akhdinirwanto et al., 2020; Uğur et al., 2020), aligns with the condition of students, especially those in rural areas. The elementary school students involved in this research generally live in rural areas. Developing observation and questioning skills for rural students not only enhances learning outcomes but also nurtures the character of environmental care. An analysis by the Organization of Economic Co-operation and Development (OECD) reveals that rural students' science learning outcomes tend to be lower compared to urban students (Echazarra & Radinger, 2019). However, fostering environmental care from elementary education supports sustainable economic development.

Conclusion

Observing and questioning are two fundamental science process skills needed in science education. Both skills are interrelated, especially in inquiry activities. New information from observation processes influences the existing cognitive structure. New information can either support the old information or conflict, leading to

questions. Questioning is a skill that needs development to enhance thinking abilities. Research on 86 fifth-grade students in rural areas shows that developing both skills in science education can influence their cognitive learning outcomes. Besides, observation and questioning skills correlate positively and significantly with learning outcomes. Observation skills correlate moderately with learning outcomes while questioning skills have a strong correlation.

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Maria Senisum: conceptualization, methodology, project administration, data collection, writing-original draft preparation. Ambros Leonangung Edu: conceptualization, software, data analyzis, proofreading, writing-review and editing.

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Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

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