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Transformation of Inquiry Learning Utilizing Lake Tondano Environment to Enhance Students' IPAS Learning Outcomes

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Abstract

The persistently low IPAS (Science and Social Studies) learning outcomes among elementary school students necessitate serious attention in educational practices. This study aimed to investigate the effectiveness of an inquiry learning model utilizing the Lake Tondano environment in enhancing the IPAS learning outcomes of fifth-grade elementary school students. Employing a quasi-experimental design with a pretest-posttest non-equivalent control group, the research utilized objective tests and learning activity observation sheets as instruments, both of which had undergone validation. The findings indicate that the inquiry learning model leveraging the Lake Tondano environment significantly improved students' IPAS learning outcomes. Students participating in this learning demonstrated enhanced understanding of ecosystem concepts and critical thinking skills, alongside increased awareness of environmental issues. This learning model proved effective not only in boosting IPAS achievement but also in providing a more profound and immersive learning experience for students.

Keywords: *IPAS learning outcomes, inquiry learning model, Lake Tondano environment*

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INTRODUCTION

Elementary education serves as the fundamental basis for cultivating students' knowledge, attitudes, and quality skills. However, various study findings indicate that the quality of learning at the primary school level in Indonesia continues to face significant challenges. According to a report by the Ministry of Education and Culture (2022), approximately 60% of elementary school students have not yet achieved minimum competency standards in core subjects such as Mathematics and Science (Anggraena et al., 2022).

The persistently low student learning outcomes highlight challenges in educational implementation. Feng & Xiao (2024) demonstrated that a lack of innovation in applying learning models and insufficient connection between learning materials and real-world contexts are key contributors to this issue. Therefore, implementing learning models that are relevant to daily life, by utilizing the surrounding environment as a learning resource, becomes highly important (Kinshuk et al., 2016). Outcome-oriented learning aims to foster critical, creative, and collaborative thinking skills (Vijayakumar Bharathi & Pande, 2024). In this regard, the inquiry learning model facilitates students' active engagement in the

knowledge discovery process, positioning it as a viable solution for improving learning outcomes.

This problem is more pronounced in rural areas, which tend to have limited access to learning resources and a lack of material relevance to real-life situations. Farida et al. (2024) found that students in rural areas struggle with understanding abstract concepts due to limited facilities and an absence of direct links between lesson materials and their local environment. One such area facing these conditions is Minahasa Regency, particularly the region around Lake Tondano, where student IPAS learning outcomes remain relatively low, despite its surrounding environment holding significant and diverse educational potential.

Lake Tondano, as an ecologically and socio-culturally rich natural resource, has not been optimally utilized as a learning resource. Nevertheless, environment-based learning approaches have proven capable of increasing student motivation and conceptual understanding regarding ecosystems (Hartini et al., 2018; Deveci & Karteri, 2022). In the context of sustainable education, leveraging the local environment as a learning resource is also highly relevant to achieving the Sustainable Development Goals (SDGs) (Kopnina, 2020).

In line with the demands of 21st-century education, students need to be equipped with critical thinking, creativity, communication, and collaboration skills (the 4Cs) (Thornhill-Miller et al., 2023). The inquiry learning model is an approach that can encourage students' active involvement in the learning process through exploration, observation, data collection, and conclusion drawing. While this model has been extensively researched, most of its implementations have not deeply integrated unique local ecological contexts into the learning process.

Several previous studies have explored environment-based learning. Hartini et al. (2018) found that environment-based inquiry learning was effective in improving conceptual understanding, but it did not significantly impact 21st-century skill enhancement and did not explicitly integrate systematic scientific inquiry stages. This finding indicates that there is still room to develop a contextual inquiry learning model comprehensively integrated with local potential, such as the Lake Tondano environment, which has the potential to provide more meaningful learning experiences and foster a change in students' attitudes towards the environment. Furthermore, Hendratmoko et al. (2023) demonstrated that the application of inquiry learning in elementary schools significantly improved students' scientific argumentation skills, yet their study did not connect the inquiry process with specific environmental contexts.

This study emphasizes the transformative potential of inquiry learning, which is designed and implemented by utilizing the ecological and socio-cultural characteristics of the Lake Tondano environment as a natural laboratory. Moreover, there remains a lack of empirical evidence specifically demonstrating how such a contextualized inquiry learning model, leveraging the Lake Tondano environment, can simultaneously improve IPAS learning outcomes, foster environmental awareness, and cultivate 21st-century skills in elementary school students.

Based on the identified problems regarding student IPAS learning outcomes and the suboptimal utilization of the Lake Tondano environment as a learning resource, this study aims to examine the effectiveness of a transformed inquiry

learning model using the Lake Tondano environment in enhancing the IPAS learning outcomes of fifth-grade elementary school students. More specifically, this research explores the contribution of this learning model to improving conceptual understanding, critical thinking skills, and fostering environmental awareness among fifth-grade elementary school students within the context of the Lake Tondano environment.

METHODS

This study employed a quantitative research approach, specifically a quasi-experimental design. The research design utilized was the "non-equivalent control group pretest-posttest design." The study was conducted with fifth-grade elementary school students residing in the Lake Tondano surrounding area. Two classes were selected through purposive sampling: an experimental class comprising 32 students (who received inquiry learning utilizing the Lake Tondano environment) and a control class consisting of 30 students (who received the expository model). Data collection was performed using IPAS learning outcome tests and observation sheets for learning activities implementing the inquiry model based on the Lake Tondano environment. The research instruments included an objective test to measure cognitive learning outcomes and observation sheets to record learning activities. Both instruments underwent a validation process, specifically expert judgment and empirical validity testing using Pearson Product-Moment Correlation, along with reliability testing using Cronbach's Alpha. Subsequently, data analysis techniques involved both descriptive and inferential statistics, conducted using SPSS 27 statistical software.

The inquiry learning model, leveraging the Lake Tondano environment, focused on ecosystem material to provide a more contextual and in-depth learning experience. The stages of implementing this inquiry learning model utilizing the Lake Tondano environment are presented in the following table:

Table 1. Inquiry Learning Stage by Utilizing the Tondano Lake Environment

Learning Stage	Teacher Activities	Student Activities
Introduction	Communicates learning objectives and links the material to the Lake Tondano environment.	Listens to the teacher's explanation and pays attention to the introduction of ecosystem material in Lake Tondano.
	Provides an overview of ecosystems and the importance of environmental sustainability.	Asks questions about the ecosystem and the Lake Tondano environment.
Exploration	Invites students to the Lake Tondano site or shows pictures/videos	Observes the conditions of Lake Tondano and records findings such as

	about the conditions and ecosystem of the lake.	various types of plants and animals.
	Guides students to identify ecosystem components (biotic and abiotic).	Records findings related to ecosystem components around the lake, such as water, air, plants, and animals.
Data Collection	Assists students in collecting data through direct observation or conversations with environmental experts.	Collects data, for instance, by measuring water quality or identifying plant and animal species around the lake.
	Provides necessary tools or materials such as water quality measurement devices.	Measures water quality.
Hypothesis Formulation	Guides students to formulate hypotheses about the relationship between human activities and ecosystem changes.	Formulates hypotheses based on observations, such as "Do human activities around Lake Tondano affect water quality?"
Experimentation or Investigation	Directs students to plan further experiments or investigations about the Lake Tondano ecosystem.	Conducts suggested experiments, namely measuring changes in water quality.
Data Analysis	Guides students to analyze the collected data and draw conclusions.	Analyzes the obtained data, such as comparing water quality and the relationships between discovered biota.
Reflection	Facilitates class discussions about student findings and the impacts observed on the ecosystem.	Discusses findings, the impact of human activities, and the importance of preserving ecosystems with peers and the teacher.
Closure	Connects the learning with environmental sustainability values and the importance of students' role as agents of change.	Reflects on the learning undertaken and understands the importance of protecting the surrounding environment.

RESULTS & DISCUSSION

Results

In accordance with the research objectives, data analysis was conducted on the pretest and posttest IPAS learning outcomes of fifth-grade elementary school students. Additionally, data were collected through observation sheets of teacher and student activities.

Description of Student Learning Outcomes (N-Gain Score)

The analysis of pretest and posttest IPAS learning outcome data revealed an increase in both classes, with a notably higher improvement observed in the experimental group. The increase in IPAS learning outcomes was measured using the N-Gain Score, with the following results:

Table 2. N-Gain Score Test Results

Class	N-Gain Score	N-Gain Score (%)
Experimental	0,62	62,02
Control	0,40	39,04

Table 2 shows that the IPAS learning outcomes, as indicated by the N-Gain score, showed a higher percentage increase in the experimental class (62.02%) compared to the control class (39.04%). The percentage increase in N-Gain score was higher in the experimental class than in the control class.

Assumption Testing for Data Analysis

Before testing for significant differences between the two groups, normality and homogeneity tests were conducted on the N-Gain Score data. All calculations were performed using SPSS 27 statistical software. The results of the normality test are presented below:

Table 3. Normality Test Results

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	Df	Sig.	Statistic	Df	Sig.
N-Gain_Percent	Experimental	0.114	32	0.200*	0.925	32	0.029
	Control	0.130	30	0.200*	0.964	30	0.398

Based on Table 3, the Shapiro-Wilk normality test results indicate that for the experimental class, the Sig. value is 0.029. Since the Sig. value of 0.029 < 0.05, the null hypothesis (H_0) is rejected, meaning the N-Gain Score data for the experimental class are not normally distributed. Conversely, for the control class, the Sig. value is 0.398. As the Sig. value of 0.398 > 0.05, the null hypothesis (H_0) is not rejected, implying that the N-Gain Score data for the control class are normally distributed.

Table 4. Homogeneity Test Results

Levene's Test for Equality of Variances

		F	Sig.

N-Gain_ Percent	Equal variances assumed Equal variances not assumed	0.001	0.971

Based on Table 4, the significance value of Levene's Test for Equality of Variances is 0.971. Since this value (0.971) is greater than 0.05, it can be concluded that the variances of the IPAS learning outcome N-Gain scores for both the experimental and control classes are homogeneous.

Test for Differences in IPAS Learning Outcomes (Mann-Whitney U Test)

Given that the normality test indicated the experimental class data were not normally distributed (despite the control class data being normally distributed and the variances being homogeneous), a non-parametric test, the Mann-Whitney U test, was employed to examine the difference between the two means. The results of the Mann-Whitney U test are as follows:

Table 5. Mann-Whitney U Test Results

Test Statistics[a]

	Learning Outcomes
Mann-Whitney U	187.500
Wilcoxon W	652.500
Z	-4.126
Asymp. Sig. (2-tailed)	<0.001

a. Grouping Variable: Class

Based on Table 5, the Asymp. Sig. (2-tailed) value obtained is < 0.001. As this Sig. value is less than the significance level of 0.05, it can be concluded that there is a significant difference in IPAS learning outcomes between the experimental and control classes.

Observation Results of Teacher and Student Activities

Observations were conducted to measure the level of implementation of the inquiry learning model utilizing the Lake Tondano environment. The observations were carried out by a single observer during the learning process in the experimental class. Assessment used a scale of 1-4, where a score of 1 indicates a very low level of implementation, and a score of 4 indicates a very high level of implementation. The observation results are presented in Table 6 and Table 7.

Table 6. Teacher Activity Observation Results

Criteria	Description	Score
Lesson Planning	The teacher clearly planned the lesson, linking ecosystem material with the surrounding environment (Lake Tondano).	4

Classroom Management	The teacher was able to manage the class well, ensuring students actively participated in exploration activities.	2
Inquiry Approach	The teacher guided students in formulating problems, developing hypotheses, and conducting experiments with adequate support.	4
Engagement in Discussion	The teacher actively facilitated group discussions and provided constructive feedback.	3
Closure and Reflection	The teacher helped students summarize learning outcomes and connect them to daily life and environmental sustainability.	4

Table 7. Student Activity Observation Results

Criteria	Description	Score
Engagement in Exploration	Students enthusiastically conducted observations and collected data on ecosystem components in Lake Tondano.	4
Data Collection	Students showed good ability in collecting data, such as measuring water quality and documenting biodiversity.	2
Creativity in Analysis	Students were able to formulate hypotheses well and analyze experimental results to draw conclusions.	3
Collaboration in Discussion	Students collaborated in groups, shared their findings, and discussed to find solutions or answer posed questions.	4
Reflection and Understanding	Students were able to connect learning outcomes with environmental problems and the importance of ecosystem preservation.	4

Discussion

The findings of this study reveal that the transformation of the inquiry learning model, leveraging the Lake Tondano environment, significantly enhanced the IPAS learning outcomes of fifth-grade elementary school students compared to the expository model. The notably higher N-gain Score observed in the experimental class (62.02%) compared to the control class (39.04%) robustly indicates the effectiveness of the implemented learning model. This finding is further supported by the Mann-Whitney U test, which demonstrated a significant difference in learning outcomes between the two classes (Asymp. Sig. <0.001).

The primary difference in the effectiveness of these two learning models can be elucidated through their fundamental approaches. The expository model, applied in the control class, tends to position the teacher as the main source of

information. Material is delivered directly through lectures or presentations, with students primarily acting as passive recipients of information. This approach, as highlighted by Acar & Tuncdogan (2019), while efficient for conveying basic concepts, often falls short in fostering deep critical thinking or problem-solving skills. Learning outcomes predominantly achieved through the expository model generally focus on the mastery of theoretical knowledge transmitted by the teacher.

Conversely, the inquiry learning model based on the Lake Tondano environment fundamentally shifts the students' role to active agents in the learning process. As emphasized in the literature (Yıldız-Feyzioğlu & Demirci, 2021), inquiry places students in relevant problems or questions, in this case by utilizing the ecological potential of the Lake Tondano ecosystem. Students are given opportunities for direct exploration, data collection, hypothesis formulation, and experimentation within a real-world setting. This process intrinsically promotes the development of critical thinking skills, the ability to independently seek information, and the capacity to connect learned concepts with the real world (Schilhab, 2021).Consequently, the inquiry model utilizing the Lake Tondano environment enables students to acquire a more profound understanding, not only of ecosystem theory but also of how this knowledge can be applied in everyday life contexts and the importance of preserving the Lake Tondano environment.

The superiority of the inquiry learning model leveraging the Lake Tondano environment lies in students' direct and active involvement in the scientific process. Unlike the expository model, where student engagement is largely confined to receiving information, this inquiry model allows students to experience the full cycle of knowledge discovery (Acar & Tuncdogan, 2019). This aligns with findings by Chu et al. (2021), who revealed that inquiry-based learning is more effective in developing higher-order thinking skills, such as observation, data analysis, and problem-solving, which are essential for 21st-century competencies. Direct engagement with the Lake Tondano environment enables students to pose authentic questions, gather tangible evidence, analyze ecological data, and draw conclusions relevant to the phenomena they directly observe. Beyond enhancing conceptual understanding, this hands-on experience also cultivates students' awareness of local environmental issues, like those found in Lake Tondano, thereby shaping their character and concern for environmental preservation (Miller, 2021).

The findings from the observation of teacher and student activities further support the effectiveness of this model. The teacher demonstrated excellent performance in planning and facilitating the learning process, connecting material to the Lake Tondano context, and guiding inquiry. Although challenges in time management for group discussions were noted (score 2), the teacher's success in creating opportunities for exploration and guiding students in problem and hypothesis formulation (score 4) was a crucial factor. Similarly, students exhibited high engagement in exploration and collaboration (score 4), which are key indicators of successful inquiry-based learning implementation. Limitations observed in the data collection stage (score 2) and creativity in analysis (score 3) highlight areas for potential improvement. Nevertheless, overall, students were active and displayed a deep understanding during the reflection stage (score 4) concerning environmental issues. This underscores that the potential of the Lake

Tondano environment as a natural laboratory can be optimally harnessed in the learning process.

Despite this study demonstrating the advantages of the inquiry learning model utilizing the Lake Tondano environment, several implementation challenges persist. One challenge is the necessity for teachers' readiness to effectively manage inquiry-based learning. Teachers must be capable of facilitating the exploration process, posing prompting questions, and assisting students in systematically analyzing data (Quintana et al., 2018). Teachers unaccustomed to this learning model may face difficulties in time management and providing adequate guidance. Another challenge is the limited resources and facilities supporting direct learning in natural environments. Not all schools have easy access to specific natural environments like Lake Tondano. Therefore, future research needs to consider alternative solutions, such as developing digital media or virtual simulations that depict environmental exploration for students unable to engage directly in fieldwork (Ahakwa et al., 2023).

However, despite these challenges, the transformation of inquiry learning utilizing the Lake Tondano environment proves to be a highly effective solution for improving the quality of 21st-century education. The increased awareness of global environmental issues, fostered by the application of this learning model, can help students understand the importance of preserving nature for the future. Students involved in environment-based inquiry learning tend to develop more positive attitudes towards natural preservation and actively contribute to maintaining the sustainability of ecosystems around them (Miller, 2021). Therefore, inquiry learning leveraging the Lake Tondano environment is highly relevant and warrants further development as an effective learning model to produce a generation that is more intelligent, critical, and concerned about the planet's sustainability, both locally and globally.

Limitations and Recommendations

This study has provided empirical evidence regarding the transformative potential of inquiry learning utilizing the Lake Tondano environment in enhancing IPAS learning outcomes among fifth-grade elementary school students. However, several research limitations should be acknowledged to guide future scholarly development. The quasi-experimental design, with its non-random group assignment, coupled with a focus on a single specific location and a limited sample size, constitutes important considerations for the generalizability of the findings. Furthermore, the use of a single observer for observational data, though planned, presents a potential for bias that should be addressed in future studies. The limited intervention duration may also not have fully captured the long-term impacts on students' attitudinal changes and the development of complex skills.

Therefore, future research is recommended to replicate this study with a more rigorous experimental design across more diverse populations and ecosystems, to deepen the measurement of its impact on broader 21st-century skills, and to enhance the reliability of qualitative data through the use of multiple observers and longitudinal studies. These steps are crucial for enriching our understanding of how inquiry learning models can optimally leverage local environments.

CONCLUSION

Inquiry learning, by effectively utilizing the Lake Tondano environment, proves highly effective in enhancing the IPAS learning outcomes of fifth-grade elementary school students, encompassing both their conceptual understanding and critical-creative thinking abilities. This learning model enables students to engage directly in the exploration and observation of local ecosystems, thereby not only acquiring theoretical knowledge but also gaining practical experiences that deepen their comprehension. Furthermore, the inquiry learning model leveraging the Lake Tondano environment significantly boosts students' awareness of environmental issues and the importance of natural preservation. Students actively involved in this learning process become more concerned about their environmental conditions and are better able to connect learned knowledge with their daily lives. Consequently, this inquiry learning model, utilizing the Lake Tondano environment, extends beyond merely achieving learning outcomes; it also cultivates students' character to be more environmentally conscious.

CONFLICT OF INTEREST

Concerning the research, authorship, and publication of this paper, the author(s) reported no potential conflicts of interest.

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