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# Effectiveness of Science Learning Using the Guided Experiment Method in Terms of Scientific Attitudes and Learning Outcomes of Fourth-Grade Elementary School Students

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**Abstract**
This research evaluates the effectiveness of science learning using guided experiment method in terms of scientific attitudes and learning outcomes of fourth grade elementary school students by examining the impact of the guided experimental method on improving learning outcomes and scientific attitudes among fourth-grade students in seven elementary schools in Jakenan Subdistrict, Pati District. Employing a quantitative experimental design, this study compares the performance of students receiving instruction through the guided experimental method (experimental class) with those following a conventional approach (control class), including a sample from SD Tambahmulyo 01 (experimental class) and eight other schools as control classes. Rigorous validity prerequisite tests were conducted. The pre-test normality test for the experimental group showed a significance value of 0.902 and for the control group 0.278, both indicating a normal data distribution. The post-test yielded a significance value of 0.063 for the experimental group and 0.356 for the control group, indicating data normality. The homogeneity test produced a Levene's statistic based on the mean of 0.062 with a significance value of 0.805, confirming the homogeneity of variances across groups. Based on the met prerequisites, further analysis shows that the guided experimental method significantly improves students' scientific attitudes, demonstrating its effectiveness not only in enhancing learning outcomes but also in fostering positive scientific attitudes.
**Keywords:** Guided experimental method; Learning outcomes; Scientific attitudes.

## Introduction

The educational world has experienced significant development, with various innovations aimed at enhancing the quality of learning. These innovations include curriculum development, learning approaches, and the improvement of facilities and infrastructure. Today's education is demanded to be more adaptive and relevant to the developments of the times, ensuring students understand the material deeply (Hasibuan, 2018; Ananda & Wandini, 2022).

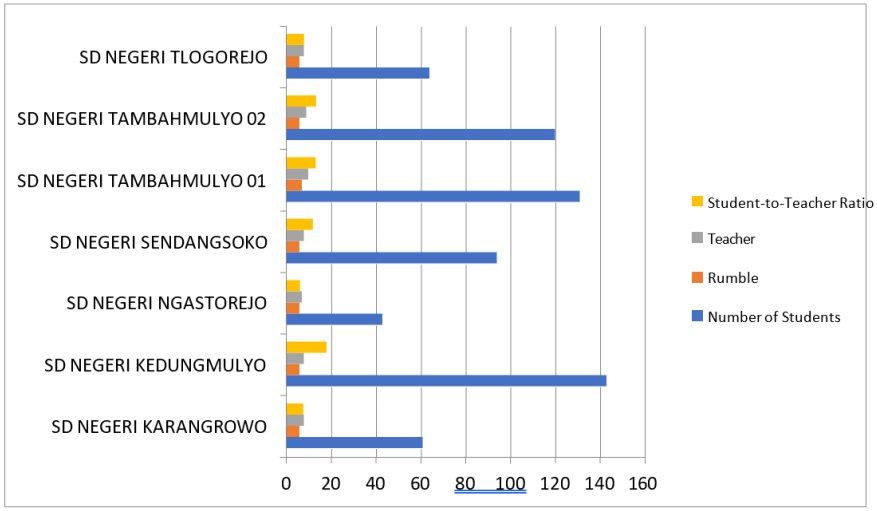


**Figure 1. Teacher and Student Ratio Chart**

Source: Processed by researchers based on raw data from School Data of Jakenan District — Dapodikdasmen (2023)

From Figure 1, it shows the data on the ratio of students to teachers in several schools in the Jakenan District, Pati Regency, and also shows a significant difference, ranging from 6.1 to 17.9. This ratio is important in determining the potential for interaction between teachers and students, which affects the effectiveness of learning, especially in experimental methods (School Data of Jakenan District – Dapodikdasmen 2023).

Previous research has shown that internal and external factors are the main causes of learning difficulties, especially in science learning. Teachers face challenges in designing effective learning strategies, which involve cooperation with parents, motivation, engaging learning strategies and media, and space for exploration (Fauzan et al., 2017).

**Table 1. School Facilities Data at Public Elementary Schools from the Diponegoro Cluster, Jakenan District, Pati Regency**

| No | School Name | Lab | Library | Internet Access |
|---|---|---|---|---|
| 1 | SD NEGERI KARANGROWO | 0 | 0 | None |
| 2 | SD NEGERI KEDUNGMULYO | 0 | 0 | None |
| 3 | SD NEGERI NGASTOREJO | 0 | 1 | None |
| 4 | SD NEGERI SONOREJO | 1 | 1 | None |
| 5 | SD NEGERI TAMBAHMULYO 01 | 1 | 1 | None |
| 6 | SD NEGERI TAMBAHMULYO 02 | 1 | 1 | None |
| 7 | SD NEGERI TLOGOREJO | 0 | 1 | None |

Source : School Data of Jakenan District – Dapodikdasmen 2023

From Table 1, it is evident that the Public Elementary Schools in the Diponegoro cluster, Jakenan District, Pati Regency, face limitations in supporting infrastructure for learning. Of the seven schools listed, only four have a laboratory room, and five have a

library room. However, the most striking limitation is that none of these schools have internet access (School Data of Jakenan District – Dapodikdasmen 2023).

Interviews with teachers of Natural and Social Sciences (IPAS) reveal that learning remains conventional and lacks sufficient involvement of students in scientific process skills. This highlights the need for more innovative learning approaches oriented towards developing process skills to improve students' scientific attitudes and learning outcomes (Asa & Buton, 2023; Sinaga et al., 2023).

The *Guided Experiment Method* is regarded as an effective solution. Previous research has demonstrated that this method positively affects science process skills and student learning outcomes (Farida et al., 2020; Hidayanti et al., 2018; Haryati et al., 2016). However, its implementation is still hindered by supporting factors such as limited learning facilities and insufficient student engagement in the learning process.

These findings open opportunities for further research on other factors that could strengthen the implementation of IPAS learning with a process skills approach using the *Guided Experiment Method*. This research is crucial to identify ways to improve scientific attitudes and learning outcomes of students, particularly in the context of science education.

The educational landscape has witnessed significant advancements, particularly in innovative learning methodologies aimed at enhancing student engagement and outcomes. Farida et al. (2020) demonstrated that the *Guided Experiment Method* positively impacts science process skills and learning outcomes among elementary students. However, their study primarily focused on urban schools with adequate facilities, leaving a gap in understanding its efficacy in resource-limited settings. Similarly, Haryati et al. (2016) highlighted the method's effectiveness in fostering scientific attitudes but noted challenges in implementation due to insufficient student engagement and teacher preparedness. These studies underscore a critical gap: the lack of empirical evidence on the *Guided Experiment Method*'s applicability in rural or under-resourced schools, where infrastructure and teacher-student ratios may hinder its effectiveness.

This study addresses this gap by evaluating the *Guided Experiment Method* in seven elementary schools in Jakenan Subdistrict, Pati District, where facilities such as laboratories and internet access are limited (School Data of Jakenan District, 2023). By comparing outcomes between experimental and control groups, the research aims to validate the method's adaptability in such contexts while measuring its impact on scientific attitudes and learning outcomes. The findings will provide actionable insights for educators in similar settings, bridging the disparity between theoretical benefits and practical implementation. Ultimately, this study seeks to contribute to the broader discourse on equitable science education by demonstrating how structured, hands-on learning can thrive even in resource-constrained environments.

## Research Methods

This research adopted a quantitative method with an experimental approach to explore the effects of a learning intervention on other variables. Using a quasi-experimental design, the study involved an experimental group that received the Guided Experiment Method and a control group that followed traditional learning processes. The research was conducted in several public elementary schools in Jakenan District, Pati Regency, during the second semester of the 2023/2024 academic year. The research stages included preparation, implementation, and data analysis from September 2023 to February 2024.

The research population was fourth-grade students from the Diponegoro public elementary school group, with samples selected through simple random sampling from SDN Tambahmulyo 02, consisting of 34 students as the control group and 34 students as the experimental group. The research variables included the independent variable (Guided Experiment Method) and the dependent variables (Scientific Attitude and Learning Outcomes of students on the Ecosystem and Food Webs material).

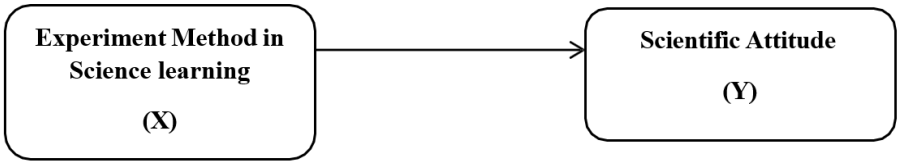


**Figure 2. Research Hypothesis Framework**

Source: Developed by researchers (2024)

Note:

Variable X: Use of Guided Experiment Method in science learning.

Variable Y: Students' Scientific Attitude.

Data collection was carried out through a rating scale to measure scientific attitudes, written tests (multiple choice and essay) to assess students' learning outcomes before and after the intervention, and documentation to collect relevant information about the students. The assessment of scientific attitudes was divided into five categories, from Excellent to Very Poor, based on how well students demonstrated scientific attitude indicators. Tests were used to evaluate students' learning achievements on the topics of Ecosystems and Food Webs, while documentation techniques helped gather additional data relevant to the research.

## Results and Discussion

The study revealed several important aspects regarding the validity of the posttest questions, observation of scientific attitudes, and analysis of the achievement scores of students' science and social studies (IPAS) learning outcomes in the context of Guided Experimental Learning. The validity test for the posttest questions showed that all questions were valid with R calculated values exceeding the R table at a 5% significance level, indicating that the questions were capable of measuring what they were supposed to measure. With a variability in the correlation levels of items, these questions also demonstrated differences in difficulty levels. Reliability statistics, measured using

Cronbach's Alpha, yielded high values (.738 for original items and .877 for standardized items out of a total of 16 items), indicating good internal consistency of the questions.

The analysis of scientific attitude observations in the experimental and control classes showed variations in the assessment of scientific attitude aspects such as Curiosity, Meticulousness, and others. Some students excelled in certain aspects while others required further development, highlighting the importance of a student-focused approach in teaching IPAS to evenly develop scientific attitudes (Putri & Susilo, 2020; Rahman, 2021).

The evaluation of the effectiveness of Guided Experimental Learning on IPAS learning outcomes was measured through pretests and posttests (Sari et al., 2015; Setiawan, 2015). The pretest results from the experimental and control classes showed a wide range of scores, with the average score of the experimental class being slightly higher than that of the control class Purwanto et al., 2021; Nurhayati & Khairani, 2021). This indicated an initial understanding of the material by the students but still required improvement (Handayani et al., 2016; Lestari & Suyatno, 2020).

Furthermore, the posttest score analysis showed that most students in the experimental class achieved mastery criteria, indicating the effectiveness of Guided Experimental Learning in enhancing students' understanding of the Ecosystem and Food Chains material (Saregar et al., 2017; Nurtanto & Sofyan, 2015). The variation in scores within the experimental and control classes, as well as the comparison of maximum, minimum, variance, and standard deviation scores between the two groups, affirmed the positive impact of the guided experimental method on students' learning outcomes (Cahyani & Kurniawan, 2021; Ibrahim, Hendrawan, & Sunanih, 2023).

Overall, this research indicates that Guided Experimental Learning is effective in improving students' scientific attitudes and IPAS learning outcomes, with valid and reliable posttest questions and a significant improvement in material understanding among students who followed this learning method (Abraham & Supriyati, 2022; Amsari, 2018).

**Prerequisite Test**

Before conducting the main hypothesis testing, several prerequisite tests were carried out to ensure that the data met certain assumptions required by the statistical techniques to be used. The two main prerequisite tests are the normality test and the homogeneity test.

**Normality Test**

Before conducting the main hypothesis testing, several prerequisite tests must be carried out to ensure that the data meet certain assumptions required by the statistical techniques to be used. The two main prerequisite tests are the normality test and the homogeneity test.

**Tabel 2. Pre-test Normality Test Results**

| Class | Sig. | Party α = 5% | Information |
|---|---|---|---|
| Experiment | 0,902 | 0,05 | Normally Distributed |
| Control | 0,278 | 0,05 | Normally Distributed |

Source: Primary data analysis using Shapiro-Wilk test (α = 0.05), processed by researchers (2024)

**Tabel 3. Post-test Normality Test Results**

| Class | Sig. | Party α = 5% | Information |
|---|---|---|---|
| Experiment | 0,063 | 0,05 | Normally Distributed |
| Control | 0,356 | 0,05 | Normally Distributed |

Source: Primary data analysis using Shapiro-Wilk test (α = 0.05), processed by researchers (2024)

Data from tables 2 and 3 present the normality test results for the pre-test and post-test values in two groups, the experimental and control groups, using a significance level (α) of 5% (0.05).

Pre-test Normality Test Results:

a. The experimental group shows a significance (Sig.) value of 0.902, which is far greater than 0.05, indicating that its data distribution is normal.
b. The control group has a significance value of 0.278, also greater than 0.05, indicating that its data distribution is normal.

Post-test Normality Test Results:

a. For the experimental group, the significance value is recorded at 0.063. Since this value is greater than 0.05, the data is considered to be normally distributed. However, it should be noted that this value is very close to the threshold of 0.05, indicating that the data is on the edge of normal distribution.
b. The control group has a significance value of 0.356 in the post-test, meaning its data distribution is normal because this value is much greater than 0.05.

Overall, both in the pre-test and post-test, both groups (experimental and control) show a normal distribution of data. This is important because the normality assumption is a prerequisite for many statistical analyses, including parametric tests that may be used for further data analysis.

**Homogeneity Test**

The testing was carried out using various approaches: using means, medians, adjusted- degree-of-freedom medians, and trimmed means to reduce the influence of extreme values. The results from all these approaches show significance values far above 0.05, indicating that there is no significant difference in variances between groups. Specifically, the test based on means produced a Levene's statistic of 0.062 with a significance value of 0.805, while the test based on medians gave very similar results, with a Levene's statistic of 0.056 and a significance value of 0.814. Even when degrees of freedom were adjusted, the results remained consistent, affirming the homogeneity of variances between groups.

**Hypothesis Testing**

With the prerequisite tests met, the study proceeded to the main hypothesis testing concerning the effectiveness of the guided experimental method on students' learning outcomes and scientific attitudes.

**Effectiveness on Learning Outcomes**

The first hypothesis test evaluated whether there was a significant difference in learning outcomes between students who followed the guided experimental method compared to the control group. Analysis using an independent samples t-test revealed a significant difference, indicating that the guided experimental method was effective in improving students' learning outcomes. This result affirms the importance of interactive and structured learning methods in enhancing students' conceptual understanding.

**Conclusion**

This study demonstrates, through thorough analysis and appropriate statistical methods, that the guided experimental method effectively enhances student learning outcomes and fosters positive scientific attitudes, underscoring the importance of active, structured learning approaches in science education. These findings provide valuable guidance for educators in designing and implementing effective strategies, particularly in under-resourced settings. Future research is recommended to explore the integration of low-tech solutions to further strengthen this method, thereby addressing practical challenges and extending its applicability. Overall, this study fills a critical gap in the literature and offers actionable insights for improving science learning where resources are limited.

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