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THE INFLUENCE OF GUIDED INQUIRY WORKSHEETS ON SCIENCE LITERACY AND LEARNING OUTCOMES IN FOURTH-GRADE STUDENTS

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Abstract

This study aims to test the effectiveness of the use of Guided Inquiry-Based Student Worksheets (LKPD) in improving science literacy and science learning outcomes of grade 4 students on the topic of changes in the state of matter. A quantitative research approach was applied using a quasi-experimental design with a non-equivalent control group. Data collection techniques in this research used written tests, student scientific literacy questionnaires, observation, interviews, and data analysis. The population is 43 students in class 4 of SDN in two schools in one cluster, namely UPT SD Negeri Jeblog and UPT SD Negeri Kaweron 2. Statistical analysis included Two-Way Anova to evaluate differences between groups. The two-way ANOVA results showed significant differences in scientific literacy and learning outcomes between the experimental group (guided inquiry) and the control group (conventional method). The experimental group showed a greater increase in scientific literacy (average N-Gain = 33.28%) than the control group (average N-Gain = 23.45%). Learning outcomes also increased more significantly in the experimental group (average N-Gain = 20.69%) compared to the control group (average N-Gain = 11.23%), with a sig. 0.042 < 0.05. Hypothesis testing shows significant differences in scientific literacy and learning outcomes based on initial abilities and learning methods (sig. 0.000 < 0.05). The use of guided inquiry-based LKPD significantly improves scientific literacy and student learning outcomes, and is recommended for encouraging critical thinking and active participation in basic science education.

Keywords Guided Inquiry Learning; Learning Outcomes; Science Literacy; Student Worksheets (LKPD).

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INTRODUCTION

Academic anxiety has become a pressing issue in education, reflecting the gap between theoretical ideals and practical realities in the classroom. This challenge is particularly evident in the integration of guided inquiry-based learning using Student Worksheets (LKPD) in elementary schools, where innovative teaching practices often fail to align with existing curricular and teaching methods. Current learning problems in Elementary Schools (SD) include low student learning outcomes and literacy levels, especially science literacy. Science literacy, as a 21st-century competency, is very important to equip students to face the challenges of everyday life. However, research results show that conventional learning methods that are widely used are less effective in encouraging literacy and learning outcomes. Lusidawaty et al., (2020) stated that limitations in teaching methods that are not varied and uninteresting student worksheets (LKS) are the main causes of low student engagement. A study by Ichsan et al., (2018) also identified that many elementary schools in Indonesia still use a lecture approach that lacks interaction, thus inhibiting students' ability to think critically and understand scientific concepts.

The 21st century emphasizes scientific literacy as an essential competency to address everyday challenges. According to Lusidawaty et al., 2020, effective science education requires a constructivist approach, which positions teachers as facilitators and students as active participants. Scientific literacy is becoming increasingly important as modern society becomes increasingly dependent on science and technology (Romli et al., 2024) the guided inquiry model has a positive impact on science learning Mazidah et al., (2023) and Sabila et al., (2019) However, in practice, conventional methods and limited learning resources continue to hamper progress. For example, in several elementary schools in Blitar, the use of traditional teaching approaches, the lack of varied teaching methods, and uninteresting student worksheets have contributed to low student achievement and science literacy levels. A study by Ichsan et al., (2018) and Kristiyanto et al., (2020) further highlights these barriers, emphasizing the need for more interactive, real-world-oriented science instruction.

This gap is also reflected in research at Blitar Elementary School, which shows that the group of students taught using conventional methods has lower scientific literacy than the group using an innovative approach based on guided inquiry Falilat et al., (2024). Conventional learning models tend not to provide students with opportunities for active exploration, formulating questions, or conducting direct experience-based investigations. As a result, students not only

lose the opportunity to develop conceptual understanding, but also their critical thinking skills (Kristiyanto et al., 2020) and the guided inquiry learning model emphasizes students to be active, increase interest, motivation, and learning independence, train courage, communicate and try to gain their own knowledge through the process of discovery and problem solving Hadi & Novaliyosi, (2019) and Juwairiah, (2021).

Recent research underscores the efficacy of guided inquiry-based LKPD in improving cognitive skills and scientific literacy. The impact of implementing E-LKPD has various impacts, namely increasing several student abilities such as critical thinking, creative thinking, scientific literacy, and scientific process skills (Reisa et al., 2024) A study by Sari et al., (2020) and Supriadi, et al., (2020) showed that combining guided inquiry with multimedia and structured investigations promoted deeper understanding and engagement among students. The implementation of guided inquiry can help students to create their concepts Zaytun Hasanah, (2021) and Melania & Yonata, (2022) These findings are consistent with constructivist theory, which advocates hands-on learning and active exploration as essential to knowledge construction.

Guided Inquiry Worksheet is one of the effective innovations to improve science literacy and learning outcomes of elementary school students. Guided inquiry teaching can stimulate students' diversity of problem definition and information collection during the creative process Wang et al., (2023). The GI learning model intentionally increases student involvement and participation in the learning process to improve science literacy (Ebokaiwe et al., 2024).This approach is in line with constructivist theory, which places students as active subjects in learning (Supardan, 2016). Compared to traditional LKS, GI Worksheets provide step-by-step exploration guidance that helps students understand concepts through hands-on investigation. Research shows that elementary school students' inquiry skills are often limited due to lack of experience and explicit guidance (Munzil et al,. 2017). Therefore, GI Worksheets are designed to support students through structured directions, such as making hypotheses, designing simple experiments, and drawing conclusions based on observations. A study by (Suprianti et al., 2021) states that this approach increases students' active participation and critical thinking skills, which ultimately strengthens their scientific literacy.

The findings of (Han, 2023) support this, showing that students who learned using GI Worksheet had an average increase in scientific literacy of 33.28% compared to 23.45% in students who used conventional methods. Likewise, learning outcomes improved significantly with the GI Worksheet approach. With an inquiry-based approach, GI Worksheet also allows students to relate learning to real life, making learning more relevant and meaningful. Another study (Erdani et al., 2020) showed that guided inquiry-based learning models can be effectively applied at various levels of education, including elementary school, to encourage deeper learning. The results of the study from Setiawan et al., (2023)based on the research results obtainedThe use of guided inquiry learning models has been proven to be an alternative to active science learning in terms of students' thinking and cognitive abilities. Scientific literacy skills also prepare students to engage in research and innovation and enable them to provide critical, evidence-based thinking on social and environmental issues Learning outcomes when implementing guided inquiry learning models follow the nature of science learning, including attitudes, processes, products, and scientific applications (Faizin et al., 2024). The results of research from Faizin et al., (2024) shows that the application of the guided inquiry learning model significantly improves students' scientific literacy.

The results show that there is an influence of guided inquiry learning model. The average and classical completeness value of experimental class greater than the control class shows that guided inquiry based on science literacy learning is better than the conventional learning related to learning outcomes (Qomaliyah et al., 2017) and (Sunarti et al., 2023) The influence of the Guided Inquiry Learning Model on Critical Thinking Skills and Science Learning Outcomes at the Elementary School Level. The results showed that the guided inquiry learning model had a positive and significant effect on science literacy and student learning outcomes in terms of cognitive, affective, and psychomotor aspects (Erniwati et al., 2020).

This study aims to examine the impact of guided inquiry-based LKPD on improving science literacy among grade 4 students, focusing on the topic of material transformation. This study seeks to bridge the theoretical and practical gap by offering evidence-based insights into effective teaching strategies, which contribute both theoretically and pragmatically to the field. The findings are expected to guide educators in implementing innovative approaches, which ultimately improve student learning outcomes and engagement. The GI Worksheet approach addresses the urgent need for learning methods that encourage interaction, exploration, and critical thinking in elementary schools. Through empirical research support, this approach has

been proven effective in addressing the problem of low scientific literacy and student learning outcomes.

METHOD

This study adopts a quantitative approach to investigate the influence of student worksheets (LKPD) based on the guided inquiry model on the science literacy and learning outcomes of 4th-grade students. The research design utilized is a Quasi-Experimental Design, specifically the Nonequivalent Control Group Design. The experimental group engaged with LKPD integrating guided inquiry methods, while the control group used conventional teaching strategies and LKPD without guided inquiry elements. The population is all 4th grade students of SDN in two schools in one cluster, namely UPT SD Negeri Jeblog 1 and 2 Blitar, totaling 43 students. In this study, the sampling technique used is saturated sampling, which was chosen because the population size is relatively small and can be fully accessed.

The population consists of all 4th-grade students from two schools in one cluster, namely UPT SD Negeri Jeblog 1 and UPT SD Negeri Jeblog 2, Blitar, with a total of 43 students. From the entire population, two groups were formed: the experimental group, consisting of 20 students from UPT SD Negeri Kaweron 02, who were given treatment using Guided Inquiry-Based Student Worksheets (LKPD), and the control group, consisting of 23 students from UPT SD Negeri Jeblog, who were taught using conventional methods with regular LKPD. Data were collected through pretests, posttests, and formative assessments (assessment for learning) conducted during the learning process. Data Collection Techniques :1) Tests: Pretests and posttests measured science literacy and learning outcomes. 2) Observation: Formative assessments and observation sheets evaluated classroom learning activities and engagement. 3) Document Analysis: Validation of the LKPD to ensure alignment with curriculum standards and its effectiveness in teaching. The analysis included statistical techniques such as normality tests, homogeneity tests, and hypothesis testing using t-tests to compare the experimental and control groups. The quantitative data were processed using statistical software to ensure accuracy and reliability. The conceptual framework of this research is centered on comparing two learning approaches: guided inquiry-based LKPD and conventional methods. The expected outcome is that the guided inquiry approach enhances students' science literacy and learning achievements.

Concept Map:

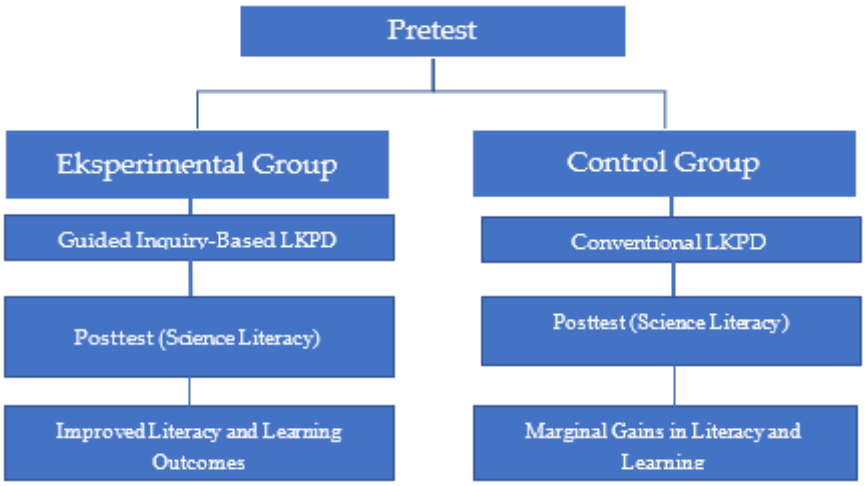

Figure 1. Concept map

There is a difference in science literacy skills between the group of students taught using the GI-based LKPD and the group taught using conventional methods. Additionally, there is a difference in learning outcomes between the group of students taught using the GI-based LKPD and the group taught using conventional methods.

FINDINGS AND DISCUSSION

Findings

This research was conducted on 4th grade students at UPT SD Negeri Kaweron 02, the number of students was 20 in the experimental class and UPT SD Negeri Jeblog as many as 23 students as the control group. Data on students' initial abilities as the basis for conducting this research in 2 classes. The results of the pretest as initial knowledge data were carried out in two different classes before the teaching and learning process of science on the material of changes in the state of objects. The implementation of this pretest was to determine the initial equality of the two treatment groups had equality or not.

Pretest Results

The pretest results for the experimental and control groups were analyzed to determine the initial equivalence of both groups. Table 1 below summarizes the findings.

Table 1. Pretest Results for the Experimental and Control Groups

Class	Number of Students	Mean	Deviation (Stdev)	Sig	Interpretation
Experimental	20	68.60	11.581	0.686	Equal
Control	23	67.83	10.290		

Source: Processed Data from Pretest Results

Posttest Results

The posttest revealed improvements in both literacy and learning outcomes. The experimental group using Guided Inquiry (GI) outperformed the control group using conventional methods.

Table 2. Comparison of Posttest Results for Experimental and Control Groups

Category	Pretest Mean (Exp)	Posttest Mean (Exp)	Pretest Mean (Ctrl)	Posttest Mean (Ctrl)	N-Gain Score (Exp)	N-Gain Score (Ctrl)
Science Literacy	68.80	79.65	67.81	76.52	33.28%	23.44%
Learning Outcome	72.73	78.55	72.41	75.57	20.69%	11.24%

Source: Processed Data from Posttest Results

Hypothesis Testing

Statistical tests were conducted to examine the significance of differences between the experimental and control groups.

Table 3. Results of Two-Way ANOVA for Posttest Literacy and Learning Outcomes

Dependent Variabel	Source	Sum of Squares	df	Mean Square	F	Sig.	Interpretation
Literacy	Group	170.636	1	170.636	5.318	0.027	Significant difference between groups
Learning Outcome	Group	3.969	1	3.969	0.412	0.525	No significant difference between groups

Source: ANOVA Test Results

Pretest results showed no significant differences between groups for science literacy and learning outcomes. The experimental group demonstrated significant improvements in literacy scores, with an N-gain of 33.28%, compared to 23.44% in the control group. While learning outcomes improved in both groups, the difference was not statistically significant, statistical Validation: Two-way ANOVA confirmed significant differences in literacy improvements favoring the Guided Inquiry approach.

Discussion

Science Literacy Skills

Improving scientific literacy skills in experimental groups using LKPD based onGuided Inquiryshowed very positive results. Student-centered learning allows students to be directly involved in the investigation process, strengthening their understanding of science concepts. The use of LKPD which provides step-by-step guidance helps students not only understand concepts but also develop critical thinking skills, analyze data, and conclude research results. This method is very much in line with the constructivist approach, where students build their knowledge through direct experience and reflection on the learning process.

Exploration activities designed in LKPD based on guided inquiry stimulate students to think critically and creatively. Students are given the opportunity to ask questions, formulate hypotheses, and conduct experiments to find answers to the problems given. With clear steps and tools and materials available in the student's environment, they are able to connect theory with everyday reality, so that learning becomes more meaningful. This process focuses on the development of scientific literacy that is not only limited to theoretical knowledge, but also on the application of scientific concepts in real-life contexts.

Meanwhile, the control group using conventional learning methods, which rely more on teacher lectures and demonstrations, experienced a smaller increase in science literacy. This indicates that more passive learning methods are less effective in improving students' conceptual understanding and skills. By using more active approaches such asguided inquiry, students can more easily connect the concepts learned with their practical experiences, deepening their understanding and enriching their scientific literacy.

The control group using conventional learning methods tended to be more passive, a smaller increase in science literacy suggests that this approach is less effective than guided inquiry. Factors that influence this are hands-on activities if in the practical experimental group that helps students reinforce concepts, in the control group student involvement in increasing student involvement and motivation contributes better (Suprianti et al., 2021). The material taught in the control group is the same as the experimental group.

The control class is taught by teachers from different schools who have a working period together and have a lot of experience, so data collection is very helpful. Learning The steps taken by teachers in the control group are at the beginning of the lesson the teacher delivers a brief

introduction to the topic to be studied, namely the change in the state of solids to liquids at meeting 1, at meeting 2 the change in the state of solids to gas, meeting 3 namely the change in the state of liquids to solids, meeting 4 the change in the state of liquids to gas, meeting 5 the change in the state of gas to solids and at the end of meeting 6 the change in the state of gas to liquid. The activities in the control group continued with the teacher explaining the learning objectives, in the core activities the teacher conveyed information about the concept of changes in the state of matter through lectures, presentations, and the use of videos. In the control group, simple experimental demonstration activities were carried out, while the teacher was demonstrating, students only looked at the teacher and the students observed and recorded the changes.

LKPD in the control group is designed to direct students in the learning process. The first step is for students to make observations, then students discuss in groups when discussing in small groups to discuss the results of their observations, after the discussion, the data analysis activity is continued and conclusions are drawn and the results are presented. The increase in science literacy in the experimental group shows that the guided inquiry approach is effective in facilitating in-depth understanding of science concepts. This is in line with the constructivism theory which states that active and collaborative learning can improve students' understanding. (Dadang Supardan, 2016) and the results of research conducted by Munzil, etc (2017) stating that guided inquiry is effective in developing elementary school students' scientific literacy.

Learning in the control class is not as active and interactive as the experimental group using Guided Inquiry, students are still given the opportunity to observe, analyze, and reflect. Thus, they can still gain a good understanding of science concepts through more structured and directed activities in line with the opinion of the results of his research stating that conventional classes with learning models that do not use guided inquiry students have difficulty in building their understanding of learning materials (Irsan, 2021).

Learning Outcomes

Based on the findings of the research, learning with the guided inquiry model has proven effective in improving student learning outcomes, especially in mastering the concept of changes in the state of matter. In the experimental group, students were able to clearly explain the process of changes in the state of matter, such as melting, freezing, condensing, and sublimating. In addition, they were able to provide real examples from everyday life related to changes in the

state of matter. This shows that the guided inquiry approach is successful in developing students' critical thinking skills and deepening their understanding of complex science concepts.

In contrast, the control group that only relied on lectures and demonstrations by the teacher showed lower learning outcomes. Although students were given the opportunity to conduct observations and discussions, their involvement in learning was more passive compared to the experimental group. This proves that more active learning methods, such as guided inquiry, are more effective in facilitating students' deep understanding and application of science concepts.

Comparison with Previous Research

The results of this study are in line with a number of previous studies showing that the guided inquiry model has a positive influence on scientific literacy and student learning outcomes. Research by (Sumariati, 2018) and (Sukma et al., 2016) revealed that the use of the guided inquiry model improves students' understanding of concepts and scientific thinking skills, as well as stimulates their curiosity. The results of this study are also in accordance with the findings of Putri et al., (2021) and Apriliani et al., (2019), which show that the use of guided inquiry is more effective than conventional learning methods in improving conceptual understanding and learning outcomes.

However, the main difference between this study and some previous studies is the context used. This study was conducted at the elementary school level (grade IV), while many previous studies were conducted at higher education levels, such as high schools (SMA). The study by Erdani et al., (2020) provides a deeper insight into the effectiveness of guided inquiry at the high school level, which shows that this approach is also effective in improving students' critical thinking skills.

Research Implications

The findings of this study have significant implications for the development of education at the elementary school level, especially in the context of the Merdeka Curriculum. The use of LKPD based on guided inquiry has not only proven effective in secondary schools, but can also be applied in elementary schools to build a strong foundation of science literacy from an early age. This learning model supports the development of students' critical and creative thinking skills, which are very important for future science education.

In addition, the results of this study can be used as a reference for curriculum development that focuses more on the application of inquiry-based learning, especially to build scientific literacy in early grades. This approach can be applied in various subjects, not only on the material of changes in the state of objects, but also on other topics that require a deep understanding of concepts.

Research Limitations Like other studies, this study also has limitations. One of them is the small sample size, which is limited to one class with a limited number of students. This can affect the generalization of the findings to a wider population. The relatively short duration of the study is also a limitation, because it cannot provide a picture of the long-term effects of using the model guided inquiryon scientific literacy and student learning outcomes. In addition, uncontrollable external variables, such as family background and student learning motivation, may also affect the results of the study. Different experiences and skills of teachers in implementing the guided inquiry model can also be confounding factors that affect the results of the study.

Steps to Overcome Limitations

To increase the validity and generalizability of the findings, it is recommended to expand the research sample by involving more schools and students. The duration of the study can also be extended to see the long-term impact of using the guided inquiry model. In addition, further training for teachers in implementing this model can help reduce external variables that can affect student learning outcomes.

Further Research

Future research can involve larger and more diverse samples to increase the generalizability of the findings. In addition, future research can focus on long-term evaluation of the use of guided inquiry-based LKPD on science literacy and student learning outcomes, as well as examining other factors that may influence the effectiveness of this learning, such as family support and student motivation.

CONCLUSION

Overall, this study shows that LKPD based on guided inquiry is an effective learning tool or device in improving science literacy and student learning outcomes. There are further efforts to overcome the existing limitations and have been proven to be true, namely strengthening evidence on the effectiveness of the guided inquiry learning model with LKPD proven to be

effective in various educational contexts.

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