Guided Inquiry: An Alternative Science Learning Technique in Improving Elementary School Students' Process Skills and Concept Mastery

Abstract:

This study aims to improve the science process skills and scientific attitudes of grade 3 students of Elementary School in Nurul Ilmi Jambi. The approach used in this study is quantitative with a quasi-experimental design. The population used in the study were grade 3 students of Nurul Ilmi Integrated Islamic Elementary School with 203 people in seven locations. The samples used were from two locations taken randomly, with a total sample of 58 people. Data were collected using test techniques for both process skill variables and concept mastery, namely using multiple choice questions of 25 questions each. Data analysis was carried out using N-gain and T-test on pretest and posttest scores. The results showed that guided inquiry had a positive impact on the development of students' science process skills and their concept mastery. Based on the N-gain test, SPS and concept mastery increased on average with the "moderate" category. Based on the T-test, it is known that each variable has a significant mean difference between the pretest and post-test tests. Therefore, at the end of this study, it is concluded that Guided Inquiry can be an alternative for teachers to Improve Elementary School Students' Process Skills and Concept Mastery in science subjects.

Keywords: Guided Inquiry, Science Learning, Science Process Skills, Science Concept Mastery

Introduction

Indonesia, as one of the world's developing countries, continues to strive to improve the quality of education at all levels. One real effort to improve the quality of education is through curriculum development and implementation of student-oriented learning. The implementation of student-oriented learning, for example, is related to process skills. However, mastery of concepts remains the main target, especially in learning science. Therefore, various efforts are made to improve process skills and mastery of concepts in each school subject.

Science process skills (SPS) are a very important part for someone in learning science to become a scientist. Darmayanti (2022) states that SPS is the ability of students to practice scientific principles to know correctly and obtain and develop knowledge. Astalini et al., (2023), Ngazizah et al. (2023), and Koomson et al. (2024) explain that science process skills are a collection of directed skills used to build and form knowledge concepts from an event or natural phenomenon through observation skills, interpreting, predicting, experimenting, and providing explanations or conclusions from the results of the experimental proof. The same thing was also conveyed by Syafiqah et al. (2024) that process skills need to be trained or developed in science learning because process skills play an important role in obtaining and developing knowledge.

The results of research by Isticharoh (2019), Ischak et al., (2020), Roa & Fajardo (2022), and Gidele (2023) show that students who have good SPS scores tend to have good academic achievements as well. Handayani et al. (2018) and Azizah, Sukarno & Hartoyo (2023) in their research said that

someone with good SPS tends to have good scientific literacy as well. In addition, SPS is also very important for someone to support their success in real life (Izzuddin et al., 2019; Khairunnisa et al., 2020; Koomson et al., 2024). Therefore, SPS is one of the main targets in science learning. Theoretically, SPS is divided into two groups, namely basic SPS and integrated SPS (Sukarno et al., 2019). Basic science process skills include the ability to observe, classify, measure, collect data, ask questions, analyze data, and communicate scientifically (Duda et al., 2019; Roa & Fajardo, 2022). Meanwhile, integrated science process skills include the ability to compile operational definitions of variables, determine hypotheses, control variables, experiment, and interpret experimental data (Syafi et al., 2022; Sarıoğlu, 2023).

In science learning, both groups of skills are very important and mutually supportive. However, in this study, the focus is on basic SPS skills which include the ability to observe, classify, collect data, analyze data, and communicate. This is done based on considerations of the condition of the sample and the subject matter as well as the learning model used. In addition to SPS, mastery of scientific concepts is also the main target in learning science. In learning science, mastery of scientific concepts is one of the main indicators to determine whether someone is successful or not in learning science (Wijaya et al., 2020; Zuhdi & Makhrus, 2020). Good mastery of science concepts indicates a student's success in learning science, and vice versa, low mastery of concepts indicates that a student must repeat or remedial in learning science (Mufidah et al., 2020). Thus, mastery is the main point and very fundamental for a teacher to teach to students.

In the Nurul Ilmi Integrated Islamic Elementary School (SDIT) in grade 3, in general, the level of science process skills and concept mastery is still relatively low. Several practical test results show that in general, the level of science process skills is still relatively far from the target, for example in terms of making observations, the ability in these skills still needs to be improved. In addition, data collection and data analysis activities also show that this section is still weak. As for communication skills, in general students also still have difficulty in conveying ideas and reading reports on their work results. Thus, serious attention is needed to improve the SPS of students in grade 3 of SDIT Nurul Ilmi Jambi. As for the variable of science concept mastery ability, the interim test results also show that in general students' mastery of science concepts is still relatively low. Approximately 68% of grade 3 students in the school still have difficulty mastering the concepts presented in the teaching materials (students' main books) and the teacher's explanation in class. This situation motivates researchers to take appropriate actions to improve students' mastery of science concepts.

According to several previous research reports, it is known that the guided inquiry learning model has a positive impact on student's learning outcomes, for example, their metacognitive abilities (Widodo et al., 2019), improving students' scientific attitudes and self-esteem (Dewi et al., 2023), improving critical thinking and elaboration skills (Sarifah & Nurita, 2023). In addition, guided inquiry can also be used as an alternative to improving students' SPS (Budiyono & Hartini, 2016; Dijaya et al., 2018), and mastery of science concepts for students (Darmayanti, 2016). However, is this model also suitable for grade 3 students of SDIT Nurul Imi Jambi? This is because previous studies involved students at the junior and senior high school levels and have not involved elementary school students, especially grade 3 with different and unique characteristics. Unfortunately, there has been no research that accurately provides information related to this, so more systematic research needs to be carried out.

Theoretically, the guided inquiry learning model is a learning model that emphasizes or prioritizes the process in learning activities. This is based on the syntax of guided inquiry learning itself. According to Dewi et al. (2023), guided inquiry learning has a sequential syntax, namely Orientation, formulating problems, submitting hypotheses, designing experiments/trials, collecting and processing data, concluding, and reflecting. According to Putri & Suharto (2019), the guided inquiry learning model involves students' abilities to investigate something through experimental activities so that students can find their knowledge. Therefore, the use of the guided inquiry learning model needs to be applied at SDIT Nurul Ilmi Jambi to answer the problem of the still low SPS and students' mastery of science.

Method

The approach used in this study is quantitative with a quasi-experimental design with a single pre-treatment and a post-treatment group design with two pre-treatment measurements (Hastjarjo, 2019). The population used in the study were 203 students of grade 3 of Nurul Ilmi Integrated Islamic Elementary School in seven locations. The samples used were from two locations taken randomly, with a total sample of 58 people. Data were collected using test techniques for both process skills and concept mastery variables, namely using multiple choice questions, each with 25 questions. Data analysis was carried out using the N-gain and T-test on pretest and posttest scores. The N-gain test was carried out to determine the effectiveness of the treatment on the sample (Wahab et al., 2021) or to determine the increase in the sample's ability in each variable measured (Sukarelawan et al., 2024). In this study, the N-gain test was carried out using Microsoft Excel software. In theory, the calculation of the N-gain test is carried out using the formula:

$$N = \frac{\text{Score obtained}}{\text{Maximum score}}\ x\ 100\%$$

Furthermore, to find out in which category the effectiveness or improvement of students' abilities on the measured variables is, categorization is carried out with the following levels:

Table 1. N-gain Classification.

N-Gain	Classification of Improvement
g > 0,70	High
0,30 < g ≤ 0,70	Medium
g ≤ 0,30	Low

In addition, the collected data was also analyzed using the T-test. The test was conducted to determine whether there was a significant difference between the pretest value group and the posttest value group which were conducted in pairs. In this study, the T-test was conducted with the help of SPSS 25 software.

Result and Discuss

Based on the measurement results of each variable, namely SPS and mastery of science concepts. Then the calculation (N-gain test) was carried out on each variable. Presentation of data in the form of a table, as follows:

Table 2. Percentage of SPS Improvement

Indicators	**Classification**	**Range of score**	**Frequency**	**Percentage**
Observation	High	76-100	18	31,03
	Medium	41-75	28	48,37
	Low	0-40	12	20,60
	Total		58	100
Classification	High	76-100	15	25,86
	Medium	41-75	29	50,00
	Low	0-40	14	24,14
	Total		58	100
Data	High	76-100	21	36,20

Collection	Medium	41-75	27	46,55
	Low	0-40	10	17,25
	Total		58	100
Data Analysis	High	76-100	12	26,70
	Medium	41-75	21	36,20
	Low	0-40	25	43,10
	Total		58	100
Communication Skill	High	76-100	12	26,70
	Medium	41-75	25	43,10
	Low	0-40	21	36,20
	Total		58	100

Based on Table 2 above, it can be seen that in general, students' SPS abilities have increased in various ways. Each SPS indicator measured in this study has a different level of increase. In the observation indicator, there was an increase in the "high" category of 18 people, or around 31.03%. Meanwhile, students with an increase in the "moderate" category were 28 people or around 48.37%, and students who experienced an increase in the "low" category were 12 people or around 20.60%. This means that the average increase in SPS in the observation indicator in science learning using guided inquiry is "moderate".

Furthermore, based on Table 2 above, it can be seen that in general, SPS abilities in the classification indicator have increased in various ways. In the classification ability indicator, students who experienced an increase in the "high" category were 15 people or around 25.86%. There were 29 students with an increase in the "moderate" category or around 50%, and 14 students or around 24.14% experienced an increase in their ability in the classification indicator with the "low" category. This means that the average increase in SPS in the science learning classification ability indicator using guided inquiry is "moderate".

As for the increase in SPS in the data collection ability indicator (Table 2), it can be seen that in general there has been an increase in various ways. In the classification ability indicator, there were 21 students, or around 36.20% who experienced an increase in the "high" category. There were 27 students or around 46.55% who experienced an increase in their ability in the data collection indicator with the "low" category, there were 10 students, or around 17.25%. This means that the average increase in SPS in the data collection ability indicator in science learning using guided inquiry is "moderate".

In addition, Table 2 above also shows that the data analysis indicator looks somewhat different from other indicators. Although the table shows that in general, the SPS ability in the data analysis indicator has increased in various ways, the increase that occurred is relatively different from other indicators. In the data analysis ability indicator, students who experienced an increase in the "high" category were 12 people or around 26.70%. Meanwhile, students with an increase in the "moderate" category were 21 people or around 36.20%, and students who experienced an increase in the ability in the classification indicator with the "low" category were 25 people or around 43.10%. This means that the average increase in SPS in the science learning classification ability indicator using guided inquiry is "moderate", but tends to be low. This shows that the data analysis indicator is the most difficult part among the other indicators. The last SPS indicator measured in this study is communication skills.

Table 2 above also shows that the communication indicator looks quite diverse. Table 2 shows that in general, the SPS ability in the communication ability indicator looks similar to other indicators. In the data analysis ability indicator, students who experienced an increase in the "high" category were 12 people or around 26.70%. Meanwhile, students with an increase in the "moderate" category were 25 people or around 43.10%, and students who experienced an increase in ability in the classification indicator with the "low" category were 21 people or around 36.20%. This means that the average increase

in SPS in the science learning classification ability indicator using guided inquiry is "moderate", but tends to be low as in the data analysis indicator.

As previously mentioned, in this study, another variable measured was students' mastery of science concepts. In the science concept mastery variable, the results of measuring this ability can be seen in Table 3 below:

Table 3. Percentage of Increase in Mastery of Science Concepts

Variable	Classification of Improvement	Range of Score	Frequency	Percentage
Mastery of Science Concept	High	76-100	20	34,48
	Medium	41-75	26	44,82
	Low	0-40	12	26,70
	Total		58	100

Based on Table 3 above, it can be seen that in general, students' mastery of science concepts has increased in various ways. Students with an increase in the "high" category were 20 people or around 34.48%. Meanwhile, students with an increase in the "moderate" category were 26 people or around 44.82%, and students who experienced an increase in the "low" category were 12 people or around 26.70%. This means that the average increase in students' mastery of science concepts in science learning using guided inquiry is "moderate". Therefore, the guided inquiry learning model can be used as an alternative to improving the science mastery of elementary school students in grade 3 at Nurul Ilmi Jambi.

Furthermore, to find out how significant the influence of the Guided Inquiry technique is, the existing data is tested using a T-test. The results of the test for both variables can be seen in Table 4 below:

Table 4. One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
SPS Pretest	11.062	30	.000	41.452	33.80	49.10
SPS Post-test	16.981	30	.000	57.581	50.66	64.51
MC Pretest	11.311	30	.000	41.935	34.36	49.51
MC Post-test	17.341	30	.000	63.903	56.38	71.43

Based on Table 4 above, it can be seen that the viable SPS and MC obtained a sig. (2-tailed) value of 0.000 <0.05. This means that there is an average difference between the pretest and posttest values for each variable. In other words, it can be said that the increase in students' SPS and MC after participating in learning with guided inquiry techniques is significant.

The results of this study, namely that there is an influence of guided inquiry learning techniques on SPS and MC, prove that this technique can be used as an alternative in developing students' SPS and MC. In addition, the results of the study also prove that the guided inquiry technique effectively plays a

role in improving the SPS and MC of students, namely grade 3 students of SDIT Nurul Ilmi Jambi. Each syntax in the guided inquiry model is strongly suspected of contributing to the development or improvement of students' SPS and MC.

Referring to the data and test results that have been carried out, this study has proven that the guided inquiry model effectively plays a role in improving the SPS and MC of students, namely grade 3 students of SDIT Nurul Ilmi Jambi. Although the two variables measured in this study experienced different increases in each indicator, on average both variables experienced an increase. Each syntax in the guided inquiry model is strongly suspected of contributing to the development or improvement of students' SPS and MC. The results of this study are in line with previous studies that the guided inquiry learning model has the potential to improve students' SPS. Several previous studies that are in line with this study include those conducted by Budiyono & Hartini (2016), Dijaya et al. (2018), Putri & Suharto (2019), that the guided inquiry model can improve the SPS abilities of high school students. In addition, other studies also show that the guided inquiry model can be used as an alternative to improving student learning outcomes, namely in the form of concept mastery (Hosnah et al., 2017; Wahid, 2023; Vii & Ambalau, 2023).

In addition, the results of this study also prove that the guided inquiry learning model can be applied to students in grade 3 of elementary school (not only students in high school and junior high school). Therefore, from another perspective, this study provides a solution for improving SPS and mastery of science concepts in elementary school students who are generally in the beginner category. Thus, these results prove that the guided inquiry learning model with its syntax can effectively improve SPS and mastery of science concepts in grade 3 students at SDIT Nurul Ilmi Jambi. On the other hand, the results of this study open up a new discourse that SPS can be taught and trained to beginner students (elementary school). This shows that there is potential for SPS development to be carried out early on. The process of developing SPS from an early age provides a great opportunity for improving general mastery of science. The improvement of general mastery of science (process skills and concept mastery) can also be interpreted as an effort to protect the world from damage. This is based on the opinion of experts that people who have good scientific literacy skills (SPS and concept mastery) have the potential to actively contribute to preserving the environment (Suhartinah et al., 2019; Hanifha, 2023; Kartini et al., 2024).

At the end of the study, it is recommended that elementary school teachers need to consider using a guided inquiry model in implementing science learning. The use of this model in a planned and systematic manner allows for an earlier and better increase in SPS and mastery of science concepts as a real effort to improve the quality of education in Indonesia. In addition, the use of a guided inquiry learning model also allows for the creation of balance and environmental sustainability in general.

Conclusion

Based on the data and test results that have been carried out, namely that each variable has a significant mean difference between the pretest and posttest tests. Therefore, at the end of this study, it was concluded that Guided Inquiry can be used as an alternative for teachers to Improve Elementary School Students' Process Skills and Concept Mastery in science subjects. The use of guided inquiry learning models in grade 3 of elementary school must pay attention to the characteristics and abilities of students and must be carried out in a planned manner.

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