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THE EFFECT OF GUIDED INQUIRY LEARNING MODEL ON STUDENTS LEARNING OUTCOMES IN MATHEMATICS EDUCATION

M. Agus Satriawan
Institut Studi Islam Sunan Doe, Indonesia
ajus.satria23@gmail.com

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Abstract

Education plays an important role in creating social order and improving the quality of human resources. This study aims to analyze the effect of guided inquiry learning models on students' mastery of concepts in mathematics learning. The method used is a quantitative experiment with a non-equivalent control group design. The research sample consisted of two groups, namely the experimental group using the guided inquiry learning model and the control group using conventional methods. Data were obtained through pretest and posttest, with validity, reliability, and t-test analysis to test the hypothesis. The results showed that there was a significant difference in concept mastery between the experimental and control groups, with average values of 84 and 72.33, respectively. The t-test results showed tcount = 3.957> ttable = 2.012, so the hypothesis was accepted. The biserial correlation coefficient of 0.650 indicates a strong influence, and the determination coefficient of 42.30% indicates that the guided inquiry learning model contributes to improving student learning outcomes. Thus, this model is recommended as an alternative learning method in improving students' understanding of concepts.

Keywords: Guided Inquiry; Concept Mastery; Mathematics learning; Experimental Method; Learning Outcomes

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INTORDUCTION

Education is one of the fundamental aspects of community life. According to Supiarmo et al., (2024), education plays a role in creating social order that allows people to live harmoniously despite differences in terms of region, language, religion, and race. In addition, the quality of a country's education also determines the quality of its human resources, which influences the development and progress of the nation. In the 2013 Curriculum, the learning developed emphasizes a student-centered approach, with an active learning pattern that is strengthened through a scientific approach and critical learning.

In the context of mathematics learning, one of the goals is to provide students with an understanding of scientific concepts (Aderibigbe et al., 2023). Concepts in learning can be interpreted as ideas or concepts that are generalized from relevant experiences. According to Zhai, (2022), conceptual mastery refers to students' ability to understand scientific meaning, both theoretically and in everyday life. Conceptual understanding is an essential aspect in the learning process. According to He & Tao, (2022), conceptual understanding includes students' ability to translate, interpret, and conclude material based on their own thoughts, not just memorizing. Deep understanding allows students to associate a concept with other concepts and apply it in solving various problems, from simple to complex.

According to Lefrida et al., (2021) explained that understanding in the revised Bloom's Taxonomy consists of seven categories of cognitive processes, namely interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining. To achieve an optimal level of understanding, effective teaching methods are needed to improve students' mastery of concepts. One of the learning methods that can be applied is the guided inquiry method. This method requires students to be active in the learning process by observing, exploring, asking questions, and formulating hypotheses (Ioannidou & Erduran, 2021). The teacher acts as a facilitator who provides guidance and direction so that students can find concepts independently. With this method, students not only gain a deeper understanding, but also develop critical thinking and problem-solving skills, which are important in facing real-world challenges.

Based on the results of interviews with science teachers of class VII SMP Satap 4 Pringgabaya, in the mathematics learning process, teachers still use conventional models, namely lectures, which make learning more teacher-centered so that students are less active in the learning process. Students do not find the concept of the lesson themselves, students

only listen, take notes and work on questions given by the teacher so that the knowledge obtained is only from the teacher. As a result, students become less active and students do not master the science concept of what they learn, and do not have high enthusiasm for learning (Luciano et al., 2021).

According to Hussen Seid et al., (2022) the problem of low mastery of science concepts is also caused by teachers rarely conducting apperception at the beginning of learning, teachers do not motivate students enough, rarely conduct practical work, and do not relate to everyday life. Therefore, student-centered learning is needed so that students are directly involved in learning and interact with each other so that they can exchange ideas to improve learning outcomes. According to Al-Kumaim et al., (2021) Students can find their own concepts from what they are learning. Student-centered learning means that students are actively building their own knowledge, while teachers only act as facilitators, motivators, and dynamicators (Capone, 2022). For this reason, teachers must be wise in determining a model that can create a conducive classroom situation and condition so that the learning process can take place according to the expected goals. Student activity in learning can affect the achievement of concepts received by students. A teacher must strive for students to be active in the learning process and find their own concepts from what they are learning so that students can master the science concepts that have been taught (Cho et al., 2021).

According to Liu et al., (2021), one of the learning methods that can be used is the guided inquiry method. This method actively involves students in the learning process, where they are invited to observe, explore, ask questions, and formulate hypotheses. The teacher acts as a facilitator who provides guidance and support to students during the learning process (Al-Jarf, 2022). The use of the guided inquiry method has the potential to provide a positive influence on students' mastery of concepts in the material on the interaction of living things with their environment. Mathematics learning is not only aimed at memorizing concepts, but also at understanding how the concepts are discovered through the scientific process (Wijiastuti & Nurhayati, 2021). One effective approach in mathematics learning is the guided inquiry method. This method allows students to be actively involved in discovering concepts through exploration and problem solving with teacher guidance.

According to Omarchevska et al., (2022), the steps in the guided inquiry learning method include presenting questions or problems, formulating hypotheses, designing experiments, collecting and analyzing data, and drawing conclusions. This process helps students develop

critical and scientific thinking skills (Darmayanti, 2022). In addition, this method also trains students to understand the relationship between the facts obtained during the experiment and how these facts are used to draw conclusions.

As stated by Franco-Mariscal et al., (2024), the process skills approach in mathematics learning is very important because it teaches students not only to understand the material theoretically, but also how to collect and connect facts in a scientific process. In addition, research conducted by Maison et al., (2021) shows that the guided inquiry learning model is effective in increasing students' motivation and mastery of concepts. Students who are active in experiments are better able to understand concepts more deeply because they connect the various information obtained into a complete picture.

The application of guided inquiry methods in learning also allows students to be more independent in learning, because they are encouraged to find concepts with teacher guidance through guiding questions. This also supports more meaningful learning, where students experience a systematic scientific thinking process, discuss, and test their own hypotheses.

Based on various studies and theories that have been described, the guided inquiry method has great potential in improving students' mastery of concepts, especially in mathematics learning. Therefore, researchers are interested in examining the effect of the guided inquiry method on concept mastery in the material on the interaction of living things with their environment at SMP SATAP 4 Pringgabaya in 2024.

METHODS

This study used a quantitative method with an experimental design in the form of a non-equivalent control group design. Two groups were selected, namely the experimental group that received treatment with the Guided Inquiry learning model and the control group that did not receive the treatment. To determine the initial equality of the two groups, a pretest was conducted, then treatment was given to the experimental group, and the final results were measured through a posttest.

This research was conducted at SMP SATAP 4 Pringgabaya on November 1–5, 2024. The independent variable in this study was the Guided Inquiry method, which was measured through indicators such as guidance in identifying problems, formulating hypotheses, designing experiments, analyzing data, and drawing conclusions. The dependent variable was

student learning outcomes, which were measured based on posttest scores with cognitive aspects assessed through multiple-choice tests. Data collection techniques were carried out through documentation to obtain student data and academic scores, as well as written tests in the form of 20 multiple-choice questions. The study population was all students of grade VII of SMP SATAP 4 Pringgabaya, with samples selected using random sampling. To ensure equality between the experimental and control groups, a homogeneity test was carried out by comparing the F count and F table values.

The research instrument was tested through validity, reliability, difficulty level, and question discrimination tests. The validity of the questions was tested using point biserial correlation, while the reliability was tested using the Kuder Richardson formula (KR-20), which showed a very strong reliability value. The level of question difficulty was categorized on a scale of too easy, easy, moderate, difficult, and too difficult, and the results of the analysis were used to determine the appropriate questions in the pretest and posttest.

RESULTS

1. Data Description

This research is an experimental research. The research investigates the possibility of a causal relationship where in the research there is actually an experimental group and a control group (Armstrong et al., 2022). The experimental group and the control group were taken from a population of 30 students in grade VII of SMP Satap 4 Pringgabaya. This research was conducted at SMP Satap 4 Pringgabaya from November 03- November 05, 2024. The purpose of this study was to determine whether the use of the Guided Inquiry learning model has an effect on Mastery of the Concept of the Interaction of Living Things with Their Environment material. Mastery of the concept is obtained through test research. Learning the Interaction of Living Things with Their Environment uses the Guided Inquiry learning model (experimental group) and learning the Interaction of Living Things with Their Environment material uses the conventional method (control group). After each group has carried out the teaching and learning process with different treatments, each group is given the same posttest, namely 20 multiple-choice questions which aim to measure the extent to which student learning outcomes have increased towards Concept Mastery. The post-test data for the experimental group and the control group can be seen in Table 1. The researcher

took the results of the post-test scores of class VII as the final data. In this final stage of analysis, the researcher conducted a normality test and a test of the average difference.

Table 1. List of Post-test Values of the Control Group (VIIA)

No.	Code	Value	No.	Code	Value
1	A-01	80	1	B-01	100
2	A-02	85	2	B-02	70
3	A-03	55	3	B-03	85
4	A-04	70	4	B-04	100
5	A-05	90	5	B-05	100
6	A-06	75	6	B-06	100
7	A-07	70	7	B-07	60
8	A-08	65	8	B-08	90
9	A-09	60	9	B-09	60
10	A-10	70	10	B-10	60
11	A-11	90	11	B-11	90
12	A-12	65	12	B-12	100
13	A-13	60	13	B-13	70
14	A-14	70	14	B-14	85
15	A-15	80	15	B-15	90
Average		1.085	Average		1.260
		72.33			84

The data obtained in this study were post-test data. From the student learning outcome data above, it is known that the average post-test score for the control group was 72.33 and the experimental group was 84. The average increase in student learning outcomes for the science subject of the interaction of living things with their environment in the experimental group was higher than the control group. These data will be used to describe the data quantitatively, so that conclusions will be obtained from the research results for hypothesis testing. The steps used to determine the effect of the Guided Inquiry learning model on the learning outcomes of class VII students with the average difference test. The formula used to test the average difference is the t-test. The data used for the t-test is the post-test score data.

2. Data analysis

The results of the normality test can be seen in Table 2. It can be seen from the table that the post-test normality test in class VII A for the significance level α = 5% with dk = 6 – 1 = 5, obtained X2 $_{count}$ = 10.3799 and X2 $_{table}$ = 11.0705. While the post-test normality test in class VII B for the significance level α = 5% with dk = 6 – 1 = 5, obtained X2 count = 10.8957 and X2 $_{table}$ = 11.0705. Because X2 count < X2 $_{table}$, it can be said that the data is normally distributed.

Table 2. Final Chi Square List

No.	Class	X2 count	X2 table	information
1	VII A	10,3799	11,0705	Normal
2	VII B	10,8957	11,0705	Normal

The results of the discrimination power test can be seen in Table 3.

Table 3. Results of the Distinguishing Power Test

Parameter	Experiment	Control
Total	1.260	1.085
N	15	15
Average	84	72.33
Variance	247.83	169.33
Standard Deviation	15.74	13.01

Ha test criteria are accepted if t $_{count}$ > t $_{table}$ With a significance level of a = 5%, dk = 15 + 15-2 = 28. T $_{table}$ = 2.012 is obtained. Based on the calculation of the research results above, t count = 3.957 is obtained and because t $_{count}$ > t $_{table}$, Ha is accepted. This means that there is a significant difference between learning outcomes on student concept mastery in the experimental group and learning outcomes on student concept mastery in the control group. Likewise, the average learning outcomes in the experimental group obtained a value of = 84 and the average control group = 72.33, meaning that the average learning outcomes of the experimental group were higher than the learning outcomes of the control group. Thus Ho is rejected and Ha is accepted, this shows that there is a significant influence of the application of the guided inquiry learning model on student concept mastery.

DISCUSSION

Based on the initial data, the researcher used the pretest of students at SMP Satap 4 Pringgabaya as the initial basis for conducting the research. In this case, the initial ability of the class that will be used as the object of research needs to be known whether it is the same or not. Therefore, the researcher took the results of the pretest scores of class VII as the initial data. The initial data of the research, the researcher conducted two statistical tests, namely the normality test and the homogeneity test. Based on the calculation, the average for class VII B was 51 with a standard deviation (S) = 11.39. While the average value of class VII A was 47.33 with a standard deviation (S) = 12.67. From the results of the calculation of the pretest scores of classes VII B and VII A, it is known that both classes are in the same condition, namely normal and homogeneous.

Based on the pretest data, the average of class VII B is higher than class VII A. This shows that the input of class VII B is better than the input of class VII A, but the average of class VII B and class VII A are still equally low. The low average of the pretest is because the material being tested has not been taught to students, so they answer questions according to the students' experiences in everyday life. The difference in the average pretest scores between class VII B and class VII A does not affect the results of the homogeneity test of the pretest of class VII B and class VII A which states that both groups are homogeneous. The researcher determined that class VII B was the experimental group and VII A was the control group. Furthermore, the two groups received different treatments, namely the experimental group using the guided inquiry learning model while the control group used the conventional method (discussion). After the learning process ended, the experimental group and the control group were given the same posttest, namely 20 multiple choice questions with 4 choices, namely a, b, c and d.

In addition, the posttest results in the experimental and control groups, the lowest score of the experimental group was 60 and the lowest score of the control group was 45. The difference in learning outcomes between the experimental group and the control group was because the experimental group used a guided inquiry learning model, where in its learning students were directly involved so that they were motivated to learn. In addition, students were given the opportunity to participate in learning and the teacher only guided students. This is in line with the understanding of guided inquiry according to Ambarsari in a journal written by Price et al. (Price et al., 2021) which explains that guided inquiry learning is group

learning where students are given the opportunity to think independently and help each other with other friends. While the control group in its learning uses conventional methods (discussion) where students are faced with a problem, which can be a statement or question that is problematic to be discussed and solved together.

Based on the comparison of the average posttest results of students using the guided inquiry learning model to the average concept mastery of students using the conventional method (discussion), it can be concluded that the group using the guided inquiry learning model is better than the group using the discussion method. This means that the guided inquiry learning model has an effect on the mastery of concepts of class VII students on the material on the interaction of living things with their environment. This is in line with Peni Setyaningrum in her research, it was concluded that the results of the study showed that the inquiry learning model was proven to have an effect on learning outcomes in the science subject of Weather and Its Influence on Humans for class VII at SMPN 1 Pringgabaya in addition to research conducted by Iin Inayati, the results of the study showed that the guided inquiry learning model was proven to have an effect on the mastery of science concepts of class VII students on the material of Plant Parts at SMP Islam Pohgading.

Based on the final data analysis on the posttest scores given to students in both the experimental and control groups. To analyze the final stage data using normality test, and mean difference test. Based on the test results, the average learning outcome of the experimental group (VII B) was 84 with a standard deviation (S) of 15.74 while the control group (VII A) was 72.33 with a standard deviation of 13.01. The applicable t-test analysis is Ha accepted if tcount > t table by determining dk = (n1 + n2-2), a significant level of 5%. From the calculation obtained dk = 15 + 15- 2 = 28, with a significant 5% so that the tcount = 3.957 while the ttable = 2.012. Because tcount > ttable, it is significant and the proposed hypothesis can be accepted. Thus, the results can be stated that: "there is a difference in mastery of concepts between students who get taught using guided inquiry learning model and mastery of concepts of using students conventional methods (discussion)".

In the research that has been conducted, there is an increase in students' mastery of concepts. Where the average value of the experimental group is 84 while the average value of the control group is 72.33. The increase in mastery of the experimental group's concepts is better because in their learning students are active in learning activities and can carry out scientific activities in finding the concepts being studied. One of the guided inquiry learning models is

doing practicums. In practicum activities, students plan their own procedures to solve problems, the teacher facilitates the investigation and encourages students to express or create questions that guide them for further investigation. The guided inquiry learning model is divided into 5 stages, where the five stages greatly determine the success or failure of the implementation of this model.

In the first stage (orientation), explore students' initial knowledge so that students are interested and ready to follow the learning process. At this stage, the teacher invites students to pay attention to the reality that occurs in the surrounding environment related to the concept to be learned and stimulates students by giving questions related to the concept. At this stage, students are given the freedom to express their opinions and discuss. This is done so that students are motivated and also to increase students' curiosity about the concept to be learned. The second stage, namely (exploration), the researcher invites students to conduct observations through group discussion activities and practicums. Group discussion and practicum learning activities have never been done by students before, so by implementing the guided inquiry learning model, each student has the opportunity to be active and actively involved in the group. Although students are given the freedom to carry out learning activities, teacher direction and guidance in class management at this stage are very much needed.

The third stage is (concept formation), in this stage students with each group carry out discussion activities. Each student from each group is given the opportunity to present the results they get and of course by upholding the values of togetherness, responsibility, tolerance, mutual respect and mutual respect. At this stage students find new concepts. However, at this stage the direction and guidance of the teacher is very much needed. The fourth stage is (application), in this stage students are faced with new situations and learning experiences about their daily environmental conditions. At this stage students can apply the knowledge they have previously obtained.

The fifth stage is (closing), at this stage the teacher ends the learning activity by evaluating the results that students have obtained. From the description, it can answer the hypothesis that learning using the guided inquiry learning model has an effect on the mastery of concepts in the science subject of the interaction of living things with their environment. This can be proven by the difference in learning outcomes in mastering concepts between the control group and the experimental group which is significant.

CONCLUSION

From the results of the research that has been done, it can be concluded that the guided inquiry learning model has proven to be influential in improving students' mastery of concepts in the science subject of the interaction of living things with their environment at SMP Satap 4 Pringgabaya. This is shown by the applicable t-test analysis is Ha is accepted if tcount> ttable by determining dk = (n1+n2-2), a significance level of 5%. From the calculation obtained dk = 15 + 15 - 2 = 28, with a significance of 5% so that tcount = 3.957 is obtained while ttable = 2.012 Because tcount> ttable then significant and the proposed hypothesis can be accepted. The mastery of the concept of students in the experimental group using the guided inquiry learning model obtained an average value of 84 while the control group using the conventional method (discussion) obtained an average of 72.33. The results of the biserial correlation coefficient calculation of 0.650 indicate that the guided inquiry learning model significantly influences students' mastery of concepts strongly. The calculation result of the determination coefficient shows a value of 42.30%. This means that the guided inquiry learning model can explain 42.30% of the learning outcomes obtained by students while 57.70% is explained by factors not examined in this study.

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