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The Effectiveness of Guided Inquiry on Understanding Mathematical Concepts

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Abstract: Mathematical learning is a teaching and learning process carried out by teachers to improve students' mastery of mathematical materials, aiming at cultivating students' thinking creativity and improving their ability to construct new knowledge. The purpose of learning mathematics is very necessary to the learning process, because with the achievement of these learning objectives, a mathematics learning process can be called successful. Based on the facts in the field students have a poor understanding of mathematics, especially in understanding what is the greatest common multiple (KPK) and least common factor (FPB) because in learning students are afraid to ask questions and teachers only use the lecture method in explaining the material. The purpose of this research is to analyze the effectiveness of the application of the guided inquiry learning model in understanding the concept of the KPK and the FPB in fourth-grade elementary school students in the Demak District. The research method is quasi-experimental, with a quantitative approach, Nonequivalent Control Group Design. The research population was all fourth-grade students of Sultan Fatah Group, Demak District. The sample in this study used 2 elementary schools, namely Public Primary School No. 5 Bintoro as the experimental class and Public Primary School No. 3 Betokan as the control class. with a purposeful sampling technique. Data collection techniques with description tests. The data analysis technique uses data description, the prerequisite test includes normality test and homogeneity test, and the final analysis (hypothesis test) with independent sample t-test. The results showed that the effectiveness of the guided inquiry learning model in understanding the concepts of the KPK and the FPB in fourth-grade elementary school students based on the sig (2-tailed) value of 0.00 with a significance level of 0.05, then value 0.00 < 0.05. Using a guided inquiry model requires students to take an active role in the learning process and use real-life experience as a starting point for learning, which is then presented. Students can also interact in group discussions and learn from friends about other experiences or the most important ideas or concepts for better learning outcomes. The suggestion from the conclusion is that teachers need to be able to make learning more meaningful for students, so teachers need to be creative in learning, and able to innovate in learning both methods, learning models, administration, and learning media.

Keywords: Guided Inquiries, Understanding the Concepts, KPK and FPB

1. Introduction

Mathematics learning is a teaching and learning process carried out by teachers to develop a student's creativity in thinking and improve the ability to construct new knowledge as an effort to improve good mastery of mathematical material (Ulfa & Puspaningtyas, 2020). The purpose of learning mathematics is very necessary for the learning process because, with the achievement of these learning objectives, a mathematics learning process can be said to be successful. The ultimate goal of learning mathematics in elementary school is to make students skilled in using various mathematical concepts in everyday life. In mathematics, every abstract concept that is newly understood by students needs to be immediately strengthened, so that it settles and lasts a long time in the student's memory so that it will be embedded in the pattern of thought and pattern action. For this purpose, there is a need for learning through action and understanding, not just rote memorization or remembering facts. Because memorization will only settle for a short time, it cannot last long in the memory of students (Harun et al., 2021).

The purpose of learning mathematics in the 2013 curriculum is to understand mathematical concepts in the learning process and apply concepts efficiently, flexibly, accurate and precise in problem-solving (Harun et al., 2021). Kilpatrick means that conceptual understanding is the ability to understand concepts, operations, and relations in

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mathematics (Pujiati, Kanzunnudin, &Wanabuliandari 2018). Concepts are objects of learning in mathematics. Opinion (Napitupulu, 2017) mathematical objects consist of facts, skills, concepts, and principles. Understanding a concept allows someone to collect, determine, and create an object or event to be an example or not an example of a concept.

When students understand a concept, they can show the steps of a process and relate it to other concepts. Students will find it difficult to understand new material if they do not understand the prerequisite material, so understanding the concept of prerequisite material is very necessary. Understanding the concept itself is a competency shown by students in understanding concepts and in carrying out procedures (algorithms) in a flexible, accurate, efficient, and precise manner (Muhamad et al., 2021). So, when students understand the concept of the material, students can use the concept in solving various problems.

The problem is that students are less able to think mathematically even though they are in high grades. Students are less able to think abstractly, understand concepts and read math problems (Al Husna & Vebrianto, 2021). If students master the prerequisite material concepts, then these students will find it easier to understand the next material concept.

Based on the results of observations and interviews conducted at Public Primary School No. 3 Betokan, the students did not understand the concept well from the students' answers. The researcher gave 2 questions about the KPK and FPB material with the criteria of the first question being more difficult than the second question. In the first question of 32 students, there are 76% of students who have not been able to apply the concept of finding multiples with a factor tree, 58% of students make mistakes in making factor trees and how to find factors from a number, and students have not been able to use, utilize, factor trees and choose procedures. or certain operations. While in the second question 47% of students were seen to make process errors, including lack of accuracy in operating numbers, not being able to apply previous concepts such as to determine the settlement area they must be able to factor in algebraic form, and some students have not mastered the material well shown by students who can't do anything at all. From the results of the analysis of student's answers, it shows that students' understanding of mathematical concepts is still low.

The low understanding of students' mathematical concepts because in explaining the material the teacher uses the lecture and question and answer method. The impact is that students are bored and do not dare to answer questions because they do not understand the mathematics material. So we need a fun learning model so that competence can be achieved. The selection of an inappropriate learning model causes boredom, monotony, and indifferent attitude in students which affects students' understanding of mathematics material. To improve students' understanding of concepts, teachers can apply learning models that emphasize students' ability to solve problems. the learning model that can be used is the guided inquiry model.

The Guided Inquiry learning model is a learning process that begins with students formulating problems, students developing hypotheses, students collecting evidence, and students testing hypotheses until students conclude, but the teacher also guides every step the student takes. Meanwhile, in free inquiry learning, students conduct research independently like a scientist (Buerk, 2021). The learning activities start from identifying and formulating problems independently of the various topics to be investigated. Then proceed with formulating hypotheses, designing and conducting experiments, collecting and analyzing data, interpreting the results of data analysis and discussing the findings, and ends with concluding (Cakir, 2008).

The advantages of the inquiry learning model are that the teacher can provide space for students to explore knowledge that is to the student's learning style. Therefore, students can develop students imagination so that they can gain a strong understanding.

Research by Seranica, Purwoko, & Hakim (2018) shows that the guided inquiry model is effective in improving critical thinking skills guided inquiry model can invite students to think critically about things around their environment. Giving examples of daily life materials adapted to the local environment makes students easier for students to understand them (Ramadhani & Aprilianingsih, 2020) with research results, it can be concluded that the ability to understand students' mathematical concepts by applying the Guided Inquiry learning model is better than the ability to understand students' mathematical concepts in conventional learning in class VIII Madrasa Tsanawiyah Al Islam Petalabumi.

Research by Suratno, Tonra, & Ardiana (2019), with the results obtained: 1) There are differences in mathematical reasoning abilities between students who receive guided inquiry learning and students who receive conventional learning. The mathematical reasoning ability of students who received guided inquiry learning was higher than students who received conventional learning; 2) There are differences in mathematical communication skills between students who receive guided inquiry learning and students who receive conventional learning. The mathematical communication ability of students who received guided inquiry learning was higher than students who received conventional learning. The difference with this study is that guided inquiry is used to improve mathematical reasoning and communication skills, while this research is for understanding concepts in fourth-grade elementary school students.

Inkury learning is a learning model that seeks to instill the basics of scientific thinking in students so that in the learning process students learn more on their own and develop their creativity in solving problems so that students are truly placed as learning subjects. Based on the stages of inquiry learning, it is hoped that a pleasant learning process will occur so that it leads to the achievement of a good understanding of the concept. The characteristics of free inquiry

activities are: 1) Students develop their ability to make special observations to make inferences; 2) The learning objective is the process of observing events, objects, and data which then leads to the appropriate generalization structure; 3) The teacher only controls the availability of materials and suggests initiation materials; 4) From the available material, students ask questions without teacher guidance (Andrini, 2016).

1.1 Conceptual Framework

The low mastery of the mathematical concepts of KPK and FPB material in grade IV Elementary School caused the use of learning models that are not able to arouse students' enthusiasm or motivation. So that students find it difficult to understand the subject matter of the KPK and FPB. Efforts to improve students' understanding of the mathematical concepts of KPK and FPB material are by selecting learning models that can actively involve students so that student motivation can increase and finally students can understand mathematical material. The learning model that is considered to be able to improve students' understanding is the guided inquiry model.

The Guided Inquiry learning model is a learning process that begins with students formulating problems, students developing hypotheses, students collecting evidence, and students testing hypotheses until students conclude, but the teacher also guides every step the students take. With the inquiry model, it is hoped that learning will be meaningful and can be embedded in students' minds because students are allowed to do, try, and experience for themselves and not even just be passive listeners, and the teacher does not only transfer knowledge to students, but students are also directly involved. in the learning process.

1.2 Research Objectives

The research objectives analyze the effectiveness of the application of the guided inquiry learning model in understanding the concept of the greatest common multiple (KPK) and the least common factor (FPB) in fourth-grade elementary school students in Demak District.

2. Methodology

This research is a quasi-experimental method with a quantitative approach. Quasi-experimental model because this research is a daily activity in the teaching and learning process it is not possible to control all variables that affect the independent and tightly bound variables. The research design used in this study was a non-equivalent control group design. This research was conducted at Public Primary School No. 5 Bontoro, elementary school Bontoro 5, elementary school Betokan 3, Gugus Sultan Fatah, Demak District, Demak Regency. This research was carried out in semester one.

2.1 Population and Sample

The population is a generalization area consisting of objects or subjects that have certain qualities and characteristics set by the researcher to be studied and then draw conclusions (Sugiyono, 2017) The population in this study were all fourth-grade students of State Elementary Schools in the Sultan Fatah Cluster, Demak District, Demak Regency with a total of 314 students. The sample is part of the number and characteristics possessed by a population (Sugiyono, 2017). The sample selection is done using a purposeful sampling technique.

Table 1: Research Sample

No.	Class	School	Total students	Learning Model
1	IV	Public Primary School No. 5 Bintoro	40	Guided Inquiry Model
2	IV	Public Primary School No. 3 Betokan	32	Direct
Total			**72**	

2.2 Research Variable

According to Sugiyono (2017) variables are everything in any form determined by the researcher to be studied so that information is obtained about it, then conclusions are drawn. The variables in this study include independent and dependent variables. The independent variable of this research is the guided inquiry model. The dependent variable of this study is the understanding of the mathematical concepts of the KPK and FPB material.

2.3 Data Collection Technique

The data collection method in this research is the test method. According to Widoyoko (2017) tests are several questions that require answers or many statements that must be given response or response to measure a person's level of ability or reveal certain aspects of the person being tested. The test was carried out twice, namely pre-test and post-test. Pre-test.

Documentation technique is one way to collect research data indirectly, meaning that data is obtained through supporting documents related to the data to be studied. The documentation used in this study includes the syllabus, lesson plans, and research photos.

2.4 Research Instrument

The instrument used in this study was a test question in the form of a limited description of 15 items of description. Limited description questions are used to measure the level of understanding of students' concepts about KPK and FP material.

2.5 Data Analysis Technique

The data analysis technique includes the validity test of the questions (validity test, reliability test, difference power test, and test difficulty level of the question). Data analysis is a data description, analysis prerequisite test, and hypothesis testing using an independent sample t-test.

3. Findings and Discussion

3.1 Pretest and Posttest Data

The research data consisted of data from pre-test and post-test results, in the control class and the experimental class. The results of the pre-test are used as data to measure the initial ability of students' conceptual understanding, and the post-test results are used to determine the level of conceptual understanding and the final ability of students after carrying out learning activities in terms of understanding concepts learning outcomes in the control class and the experimental class.

Table 2: Analysis Data *pre-test*

		Control Class	Guided Inquiry Class
Sample	Valid	32	40
Mean		31.97	32.42
Median		30.00	31.50
Std. Deviation		8.971	8.403
Minimum		15	12
Maximum		48	58

The average value of the control class pretest was 31.97 and the guided inquiry class was 32.42. The pre-test scores for the control class and the experimental class have almost the same average value so there is no significant difference in the abilities of the three classes.

Table 3: Analysis of post-test Data

		Control Class	Guided Inquiry Class
Sample	Valid	32	40
Mean		48.03	68.48
Median		48.00	67.00
Std. Deviation		7.028	10.768
Minimum		33	48
Maximum		64	91

The average value of the control class was 48.03 and the guided inquiry class was 68.48. There is a difference, there is a significant average value with KKM 65, so the control class has an average below the KKM and the guided inquiry class has an average value above the KKM.

The results of the analysis of the average pre-test and post-test scores in the guided inquiry class increased the same as in the control class. The increase in the average score in the guided inquiry class was 36.06. This increase is much higher than the increase in the average score in the control class which is only 15, 28. The understanding of concepts between the experimental class and the control class is different because students learn through experience as a source of learning or learning, not just material that comes from the teacher and during the learning process. Students are assisted with practical that can make it easier for students to understand the subject matter. Based on the results of the gain score test analysis, it can be seen that the learning process with the guided inquiry learning model can improve the understanding of students' concepts in the high category.

Nadarajan & Sivakumaran. (2021) states that guided inquiry involves students in answering the teacher's questions, in practice students make discoveries while the teacher guides and directs them to the right one. The use of this model requires students to not just answer questions or get the right answer. This model requires students to carry out a series of investigations, explorations, searches, experiments, searches, and research. So that with guided inquiry learning students will better understand the learning material and have motivation to learning.

The indicators of understanding mathematical concepts according to Andriah & Amir (2021) are: 1) restating a concept; 2) classifying objects according to certain properties (according to the concept); and 3) providing examples and non-examples of concepts; 4) presenting concepts in various ways. form of mathematical representation; 5) developing the necessary or sufficient conditions for a concept; 6) using, utilizing, and selecting certain procedures or operations; and 7) applying the concept or problem-solving algorithm.

3.2 Hypothesis Test

To answer the formulation of the problem proposed, it is necessary to test the hypothesis by using an independent sample t-test. independent sample t-test. conducted to determine the difference in the effect of student understanding using the direct learning model with the guided inquiry model in the experimental class. The results of the t-test for the hypothesis shows in the Table 4.

Table 4: Results of Independent Sample T-Test Hypothesis 2

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Concept Understanding Value	Equal variances assumed	9.119	.104	9.270	70	.000	20.444	2.205	16.045	24.842
	Equal variances not assumed			9.700	67.509	.000	20.444	2.108	16.238	24.650

The average value in Table 4 for the two classes there is a difference in the statistical group in the guided inquiry class of 68.48, while the control class is 48.03. The value of sig (2-tailed) is 0.00 with a significance level of 0.05, then the value is 0.00 <0.05. Because sig 0.00 < 0.05 then the decision is Ha is accepted.

Guided inquiry is an inquiry learning model designed to teach concepts or relationships between concepts. Guided inquiry is also a learning model in which the teacher guides students to carry out activities by asking initial questions that lead to a discussion. The teacher gives an active role in determining the problem and the stages of the problem and the stage of solving it. So, the guided inquiry is one of the inquiry learning models which is a discovery learning model on material concepts which is carried out through discussion. Students are given how many questions and students find their problems with the guidance of the teacher.

The inquiry model emphasizes the process of inquiry to answer questions. Therefore, inquiry learning is a process based on search and discovery through systematic thinking. The application of the inquiry learning model will provide direct learning experiences to students, and learning will take place with a scientific approach. The inquiry model emphasizes the inquiry process to answer questions. Therefore, inquiry learning is a process based on search and discovery through systematic thinking. The application of the inquiry learning model will provide direct learning experiences to students, and learning will take place with a scientific approach.

The results of this study are in line with the results of research of Purwanita, Riyanto, & Suyanto (2019), which shows that the application of the inquiry learning method has a positive and significant effect on student learning outcomes (Yudatika & Jauhariyah (2021) research on the effectiveness of guided inquiry on students' conceptual understanding with the results of the study showing that the guided inquiry learning model is effective for improving science process skills and understanding the concept of the guided inquiry learning model which is different from the learning model commonly used by teachers because learning This makes a pleasant impression, students are enthusiastic to take lessons and can work well together in discussion groups.

The application of the question-based guided inquiry learning model is effective for understanding the concept. This is because the guided inquiry learning requires students to find and find their own concepts in a learning material, which in this study focuses on the interaction of living things with their environment. The application of guided inquiry learning invites students to always think in solving real problems related to the interaction of living things with their

environment, so that the information that students get can be stored longer in brain memory. Students who are independent in constructing knowledge and solving problems will make them really understand the concepts learned in the interaction of living things with their environment (Herranen & Aksela, 2019).

Student-centered learning will make students involved maximally so that students bring out their abilities in searching and investigating systematically, critically, logically, analytically, so that they can formulate their own findings with confidence. Learning that gives students many opportunities is called meaningful learning. Meaningful learning will make it easy for students to remember the material and provide a deep understanding of concepts.

The results of the research are the same as the results of research from several parties, namely Ismail, Arnawa, & Yerizon (2020); Sukariasih et al. (2019); Nursuhud et al. (2019); Yeritia, Wahyudi, & Rahayu (2017); Kimberlin, & Yezierski (2016) the results obtained indicate that the application of the model inquiry learning can improve students' conceptual understanding and communication skills. Thus the guided inquiry learning model in this study was effective in increasing students' understanding of the KPK and FPB concepts.

The results of the research above are following the opinions of experts who state that guided inquiry learning is more effective in increasing understanding of the KPK and FPB concepts compared to the direct learning model. In addition to being the opinion of experts, it is also relevant to several studies that have been carried out previously.

4. Conclusions and Recommendations

The conclusion from this research is that: there is the effectiveness of the guided inquiry learning model is better than direct learning in understanding the concepts of KPK and FPB in fourth-grade elementary school students. The use of the guided inquiry model requires students to play an active role during the learning process and students are trained using real experiences as the beginning of learning which is then presented. Students also interact with each other in group discussions to find out other experiences from friends or main ideas or concepts to achieve more optimal learning outcomes.

Suggestions from the conclusion are teachers must be able to make learning more meaningful for students so that teachers must be creative in learning, and able to innovate in learning both methods, learning models, administration, and learning media.

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Conflict of Interest

The authors declare no conflicts of interest.

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