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IMPLEMENTATION OF THE DISCOVERY LEARNING MODEL TO IMPROVE STUDENTS' UNDERSTANDING ABILITIES OF FRACTIONS IN GRADE IV

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ABSTRACT
The background of this study is the lack of students' mathematical conceptual understanding based on pre-research results. A conceptual understanding test on fractions showed that only 40% of students achieved the maximum score. The purpose of this study was to determine the improvement in students' conceptual understanding after the discovery learning model was implemented on fractions. The research method used was quantitative, and this was an experimental study with a one-group pretest-posttest design. The population and sample size were 25 students. The sample was selected using a non-probability sampling technique. The instruments used in this study were a mathematical conceptual understanding test and a student response questionnaire. Data analysis techniques used in this study were a dependent t-test with a significance level of 0.05 and an N-Gain test. The results showed a difference in students' conceptual understanding before and after the discovery learning model was implemented on fractions in fourth grade. Therefore, students' mathematical conceptual understanding significantly improved after the discovery learning model was implemented on fractions. The increase in students' mathematical conceptual understanding based on the N-Gain score was mostly in the moderate category, namely around 60%. While the remaining 40% were in the high category, including the high category, indicating that the discovery learning model is effective when applied to fraction material.
Keywords: Discovery learning; fractions; mathematical conceptual understanding

ABSTRAK
Latar belakang penelitian ini adalah kurangnya kemampuan pemahaman konsep matematis siswa berdasarkan hasil prariset diberi tes kemampuan pemahman konsep materi pecahan hanya 40% siswa dari nilai maksimal. Tujuan penelitian ini adalah untuk mengetahui peningkatan kemampuan pemahaman konsep siswa setelah diterapkan model pembelajaran discovery learning pada materi pecahan. Metode penelitian yang digunakan yaitu metode kuantitatif dan jenis penelitian ini eksperimen dengan desain one group pretest-postest desain. Populasi dan sampel penelitian ini sebanyak 25 siswa. Pemilihan sampel menggunakan teknik non probability sampling. Instrumen yang digunakan dalam penelitian ini yaitu tes kemampuan pemahaman konsep matematis dan angket respon siswa. Teknik analisis data yang digunakan dalam penelitian ini dengan uji t-dependen dengan taraf signifikansi 0,05 dan uji N-Gain. Hasil penelitian menunjukan bahwa terdapat perbedaan kemampuan pemahaman konsep siswa sebelum dan sesudah diterapkannya model pembelajaran discovery learning pada materi pecahan di kelas IV. Jadi, kemampuan pemahaman konsep matematis siswa meningkat secara signifikan setelah diterapkan model pembelajaran discovery learning pada materi pecahan. Peningkatan kemampuan pemahaman konsep matematis siswa berdasarkan nilai N-Gain sebagian besar memiliki peningkatan dengan kategori sedang yaitu sekitar 60 % Sedangkan sisanya yaitu sebesar 40 % berada pada kategori tinggi termasuk kategori tinggi, menunjukkan bahwa model pembelajaran discovery learning efektif diterapkan pada materi pecahan.
***Kata kunci**: Discovery learning; pecahan; pemahaman konsep matematis.*

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Introduction

According to Mariyam et al. (2018) this process is carried out so that students have the ability to understand concepts, fluency of procedures and problem solving. One of the basic abilities that elementary school students must have is the ability to understand concepts. This is because understanding concepts is the basic foundation for thinking in building students' initial mathematical knowledge where to form their own knowledge in understanding mathematical ideas, being able to explain them again using their own language and being able to apply them. According to Nababan & Tanjung (2020) Therefore, students' ability to understand concepts is one of the important goals as a key to continuing lessons in other fields of knowledge in understanding and mastering mathematical concepts since students are in elementary school.

In addition to understanding ideas and constructing knowledge, conceptual understanding is also an important aspect for solving problems. According to Verina & Darhim (2023) Students must have an understanding of mathematical concepts, where conceptual understanding is closely related to problem-solving abilities. If students understand concepts well, they will find it easier to solve a problem. According to Wahyuni & Prihatiningtyas (2020) Learning concepts means students must understand the existing concepts. Therefore, in learning mathematics, students must first understand the concepts in order to solve problems and be able to apply the learning in everyday life. The importance of conceptual understanding for students to have is not balanced with the results, because several studies show that students' conceptual understanding abilities are still low in the learning process. This can be seen in the results of research conducted (Pujiati et al., 2018) in grade IV of SD 3 Gemulung Pecangaan, Central Java, where the study showed that students' conceptual understanding abilities were low due to variations in monotonous learning models. In Pujiati's study, the conceptual understanding ability was examined in the KPK material, while in this study, it was examined in the fraction material, so it will refer to the differences in the research results.

Based on the results of observations conducted while in class, it was found that during mathematics learning almost 60% of students were less active, students seemed to daydream or do other activities that were not related to the lesson, such as frequently going in and out of class, students seemed not focused on listening to the teacher's explanation, students were just silent if the teacher asked questions, learning was mostly still centered on the teacher (Teacher Center), where the teacher explained, gave examples of questions, exercises, and actively communicated in class, so that students were only recipients and passive students received learning from the teacher. These results show that fraction material is difficult to understand and students' understanding of fraction material is still low. Even though fraction material is one of the important materials in the curriculum in elementary schools because fraction material is a prerequisite for the next material.

Based on the problems described above, improvements are needed in the learning process, particularly in mathematics lessons implemented in the classroom. These improvements can begin with improvements to the models, strategies, methods, and approaches used in learning. One learning model that is expected to address these issues is the Discovery Learning model.

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According to Sunarto & Amalia (2022), the Discovery Learning model emphasizes students' ability to discover concepts independently, positively impacting their mathematical conceptual understanding. Discovery learning also helps students understand the material and the interrelationships between it, making it more memorable due to the meaningful learning process.

The discovery learning model also has advantages and disadvantages. According to (Sibuea et al., 2019), while (Nurjani, 2019), the disadvantages include the time-consuming nature of the discovery learning model, limited rational thinking skills, and not all students are able to participate in this type of learning. This means that each learning model has advantages and disadvantages, which can be considered and adapted to the student's abilities and needs.

Learning mathematics using the discovery learning model, students are expected to be able to discover concepts and principles through their own mental processes, to discover concepts, students make observations, classify, make predictions, explain, draw conclusions and so on to discover several concepts or principles (, Aisa Nikmah Rahmatih, 2020). Proper conceptual understanding must be given since students are in elementary school, because understanding the concept is needed in understanding the concept of knowledge at the next level. In other words, understanding mathematical concepts requires students to understand previous material or prerequisite material in order to understand the material to be studied next (Brinus et al., 2019). This shows that in elementary school it is necessary to start the formation of conceptual understanding that begins with real things.

According to Mawaddah & Maryanti (2016), indicators of students' understanding of mathematical concepts include restating the concept, classifying objects according to certain characteristics, presenting examples and non-examples of the concept, presenting the concept as a mathematical representation, using certain procedures, and applying the concept to solve problems in mathematics learning. Understanding mathematical concepts can be used to solve problems related to the concept. Connecting concepts with other concepts is a must in the problem-solving process (Ermiana et al., 2022).

Based on the background that the purpose of this study is to examine how the application of the discovery learning model in improving students' conceptual understanding of fractions in grade IV. This objective is necessary because the level of conceptual understanding ability, especially in fractions, based on pre-research results, shows that students do not understand the material. This is caused by several factors, both internal and external, one of which is the learning model applied is monotonous, that's all. So by applying the discovery learning model, it is expected to be able to improve the ability to understand concepts in fractions.

Research methods

The research method used in this study is quantitative research with an experimental type. The sample was grade IV of SDN 15 Singkawang with a total sampling technique of 25 students. The research design used was a pretest-posttest nonequivalent control group design. The data collection techniques used were a test of students' mathematical concept understanding abilities and a student response questionnaire. Furthermore, a pretest was conducted before being given treatment

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and a posttest was given after the treatment at the end of the learning. The test is also useful as a measuring tool to obtain some information about student abilities (Pandra & Fauziah, 2024). The test instrument used was valid and reliable with a reliability level value of 0.48. Furthermore, a normality test was carried out to complete the prerequisite test, namely the Shapiro Wilk Test formula was used because it was carried out to determine the distribution of small data, namely less than (N < 50) samples and a homogeneity test of variance was carried out to see the similarity of variances in both groups. The data were analyzed univariately with a significance level of 5% (0.05). For testing the first hypothesis, a paired dependent t-test was used and for testing the second hypothesis, the N-Gain test was used.

Results and Discussion

The study was conducted from August 1 to October 22, 2024, in fourth-grade students at SDN 15 Singkawang. Prior to conducting the study, the researcher piloted the fractions material instrument, consisting of three questions, in fourth-grade students at SDN 8 Singkawang. After the pilot test, it was concluded that the number of questions used in this study was three essay questions. Prior to the learning process, the researcher conducted a pretest to determine students' initial abilities. The summary of the pretest results can be seen in Table 1.

Table 1. Pretest Data Summary

Lowest Score	Highest Score	Average
17	58	33

Table 1 shows that students' scores have not yet reached the learning objective achievement criteria, which is 70. Based on these data, the highest score obtained was 58 and the lowest score was 17, with the average score obtained by students being 33. Therefore, from the pre-test data, it can be concluded that students' mathematical conceptual understanding is still in the low category. After observing students' initial abilities, a learning process using the Discovery Learning model was implemented on fractions. At the final meeting, students were given a final test or posttest to determine their final abilities. Students' final abilities are students' mathematical conceptual understanding abilities in understanding concepts on fractions in grade IV of SDN 15 Singkawang, which is the result of students' mathematical conceptual understanding after going through a series of learning processes. The recapitulation of the post-test results can be seen in Table 2.

Table 2. Post-test data recapitulation

Lowest Score	Highest Score	Average
58	100	77

Based on Table 2, it is known that the average value obtained by students is 77 with the highest value obtained by students being 100 and the lowest value being 58. Based on the recapitulation of pre-test and post-test score data, it can be concluded that there was an increase in student learning outcomes in the final test after the Discovery Learning learning model was implemented. The increase in the average value from pre-test to post-test was 33 to 77. Conclusions from the data can

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be obtained after statistical hypothesis testing. Before testing the hypothesis, a normality test and a t-test were first conducted on the data. The normality test for student test results in the study used the Shapiro Wilk test formula. The recapitulation of the results of the normality test for the difference in pre-test and post-test scores can be seen in Table 3.

Table 3. Summary of Shapiro Wilk Normality Test

Statistics	**Experimental Class**	
	Pre-test	***Post-test***
W_{hitung}	0,925	0,945
Number of Students	25	25
Difficulty Level	5%	5%
W_{tabel}	0,918	0,918
Decision	H_0 Accepted	
Conclusion	Normally distributed	

Based on Table 3, it shows that the data obtained for the difference in pretest and post-test values is Wcount = 0.945 and the WTable value is 0.918. Thus, W$hitung$ > W$tabel$, then the data for the difference in pre-test and post-test is stated to be normally distributed. If the data is normally distributed and the population standard deviation is unknown, then to test the hypothesis, use the dependent t-test formula. The statistical hypothesis tested is the ability to understand mathematical concepts of fourth-grade students of SDN 15 Singkawang after the application of the Discovery learning learning model on fraction material has increased. The testing criteria are that the t-test is accepted if $thitung < ttabel$ and t-test is rejected if $thitung \geq ttabel$ with a significance level of α = 0.05 and degrees of freedom = n-1. The summary of the t-test results can be seen in Table 4

Table 4. Results of the Dependent T-Test Calculation

Class	$\bar{d}$	α	t_{count}	t_{table}	**Decision**
Experiment	44,08	5%	22,970	2,064	H_a Accepted

Based on Table 4, it is known that t_{hitung} 22,970 and t_{tabel} 2,064. So it is obtained t_{count} (22,970) > t_{table} (2,064) meaning Ha is accepted and Ho is rejected. So it can be concluded that there is a difference in students' conceptual understanding ability before and after the application of the discovery learning model on fraction material in class IV SDN 15 Singkawang.

To determine the increase in students' mathematical concept understanding abilities after participating in the discovery learning model lesson, an N-Gain test must be carried out. In this study, students' conceptual understanding abilities will be measured, consisting of 3 indicators, namely: (1) restating a concept; (2) Providing examples and non-examples of the concept; (3) applying concepts or problem-solving algorithms. The recapitulation of the number of students with overall N-Gain values is presented in Table 5.

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Table 5. Summary of the Number of Students with Overall N-Gain Scores

N-Gain Range	Category	Number ofStudents
N-Gain > 0,70	High	10
0,30 < N-Gain ≤ 0,70	currently	15
N-Gain ≤0,30	Low	0

Based on Table 5, it is known that most students have increased in the medium category, namely around 60%. While the remaining 40% are in the high category, so it can be seen that overall they are only in the two high and medium categories.

The results of the study showed that there was a difference in students' conceptual understanding abilities before and after the application of the discovery learning model on fraction material in grade IV of SDN 15 Singkawang. This result was caused by the application of the discovery learning model. Before the application of the discovery learning model, the pre-test results showed that students' mathematical conceptual understanding abilities were still in the low category. After the application of the discovery learning model, the post-test results showed that students' mathematical conceptual understanding abilities were still in the high category. In this case, it means that strategies or even learning models are needed that are able to improve students' mathematical conceptual understanding abilities, especially by applying the discovery learning model. Factors that cause differences and improvements before and after the application of the discovery learning model are class mastery by the teacher, then the teacher needs to vary the application of the learning model so that it is not the same, and the need for special attention to students who do not understand the material being taught. This is in line with (Moko et al., 2022) in the learning process with this model, teaching and learning activities become more active, because there are a number of activities carried out by students directly.

Another step in the Discovery Learning model that can improve students' conceptual understanding is data processing. In this step, students are invited to solve a problem. When students process data, namely by discussing to investigate fractions with a numerator of one and fractions with the same denominator and solving questions in the Student Worksheet (LKPD). With these activities, students can solve the given problems and apply concepts or problem-solving algorithms. Next, the proof step, in this step, students are invited to prove or compare the results of their findings. When students prove their findings or answers from what is obtained, students are able to distinguish between right and wrong answers, with existing concepts, thus helping students understand which are examples and non-examples of a concept.

The discovery learning model is more student-centered, rather than teacher-centered. Direct experience and the learning process are the primary benchmarks in its implementation. As stated by (Rahman, 2022), the discovery learning model emphasizes students' direct experiences in the learning process, rather than solely the final results. The strength of this study is that it has found that the discovery learning model can improve students' understanding of mathematical concepts,

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especially in fractions. A drawback is that this study was limited to only one class, which may be a limitation of this study.

This is in line with research conducted by (Baroroh et al., 2023) from the results of their research conclusions that there is an average ability to understand mathematical concepts of students after the application of the discovery learning learning model is better compared to the average ability to understand mathematical concepts of students before the application of the discovery learning model. This proves that there is a difference in the ability to understand mathematical concepts of students who use the discovery learning model is better than before using the discovery learning model. In terms of hypothesis testing that has been carried out, the results of this study are in line with the opinion of (Hayati et al., 2022) who said that one of the learning models that can have a positive influence on students' understanding of mathematical concepts is the discovery learning model.

Students' initial conceptual understanding was determined through a pre-test. The pre-test revealed that most students' scores were in the low category. After the discovery learning model was used, there was an increase in conceptual understanding across all indicators. This improvement was evident based on the N-Gain test of students' pre-test and post-test scores. In this study, conceptual understanding is considered an important skill for students. This finding is supported by Oktolius Siburian et al. (2024) who stated that conceptual understanding is crucial for students to understand what they are learning and facilitate higher-level learning activities. If students are able to understand concepts well, it will be easier to develop more complex mathematical skills. Conversely, if conceptual understanding is not developed, mathematics will become a subject that only has its own answers or methods, resulting in students only being able to solve problems using methods demonstrated by the teacher. Learning mathematics using the discovery learning model is an appropriate solution for developing learning (Prasasty & Utaminingtyas, 2020).

The results of the mathematical concept comprehension test of students in the experimental class showed that students' mathematical concept comprehension after using the discovery learning model was better than the results of students before using the discovery learning model. This is in line with research (Anggraeni et al., 2020) from the results of the research conclusions that the average ability to understand mathematical concepts of students using the discovery learning model there was an increase in students' mathematical concept comprehension ability after using the discovery learning model. Then with research (Huda et al., 2023) which stated that the use of the discovery learning model had a positive influence on students' mathematical concept comprehension. Therefore, it can be concluded that the discovery learning model is better than the conventional learning model as a control (Handayani & Windayana, 2017).

Based on the results of the study, it shows that the application of the Discovery learning model to the fraction material of grade IV SDN 15 Singkawang can improve students' ability to understand mathematical concepts. This means that the hypothesis in this study is acceptable, so that the problem formulation at the beginning of the study has been answered. The implications of this study: Teachers

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can apply the Discovery learning model in mathematics learning, especially on fraction material, to improve students' ability to understand mathematical concepts.

Conclusion and Suggestion

Based on the research results, it was concluded that the ability to understand mathematical concepts of fractions in grade IV students of SDN 15 Singkawang after participating in learning using the Discovery learning model has increased. Based on the conclusions above, several suggestions can be given that are expected to be carried out in future research with a wider and more diverse sample to increase the generalization of research results on the effectiveness of the Discovery learning model in improving understanding of mathematical concepts.

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