

THE EFFECTIVENESS OF DISCOVERY LEARNING MODEL TO INCREASE STUDENTS' MATHEMATICAL UNDERSTANDING ABILITY

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Abstract

Mathematics is one of the mandatory subjects that every student needs to understand. In mathematics, fractions are one of the materials that students consider difficult. Several studies have found that students cannot understand the concept of fractions well. Students' ability to understand mathematics is called mathematical comprehension ability. This ability is a basic ability in mastering mathematics. One model that is considered capable of improving students' mathematical abilities is the discovery learning model. This research aims to reveal the effectiveness of the discovery learning model in improving coastal students' mathematical understanding. This research is quantitative research using a pre-experiment design which was carried out at SDN 111 Buton in the odd semester of the 2022/2023 academic year. Based on the results of data processing and analysis, researchers found that the discovery learning model can improve coastal students' mathematical understanding abilities. These findings are evidence that this learning model can be used to improve coastal students' mathematical understanding abilities. Therefore, this model can be an alternative in improving students' mathematical abilities.

Keywords: coastal students; discovery learning; math; mathematical abilities; pre-experiment

Abstrak

Matematika sebagai salah satu mata pelajaran wajib yang perlu dipahami oleh setiap siswa. Dalam matematika, pecahan merupakan salah satu materi yang dianggap sulit oleh siswa. Beberapa penelitian menemukan bahwa siswa tidak dapat memahami konsep pecahan dengan baik. Kemampuan siswa dalam memahami matematika disebut dengan kemampuan pemahaman matematika. Kemampuan ini merupakan kemampuan dasar dalam menguasai matematika. Salah satu model yang dianggap mampu meningkatkan kemampuan matematika siswa adalah model *discovery learning*. Penelitian ini bertujuan untuk mengungkap keefektifan model *discovery learning* dalam meningkatkan coastal students' mathematical understanding. Penelitian ini merupakan penelitian kuantitatif yang menggunakan desain pre-experiment yang dilaksanakan di SDN 111 Buton pada semester ganjil tahun ajaran 2022/2023. Berdasarkan hasil pengolahan dan analisis data, peneliti menemukan bahwa model *discovery learning* dapat meningkatkan kemampuan pemahaman matematis siswa pesisir. Temuan tersebut menjadi bukti bahwa model pembelajaran ini dapat digunakan untuk meningkatkan kemampuan pemahaman matematis siswa pesisir. Oleh karena itu, model ini dapat menjadi salah satu alternatif di dalam meningkatkan kemampuan matematis peserta didik.

Kata Kunci: *discovery learning*; matematika; kemampuan matematis; pre-experiment; siswa pesisir

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Introduction

Education is one of the important sectors in improving the standard of living of a nation within a country. Education can be one of the keys for a nation in transforming a country into a developed country (Sartono et al., 2021; Sartono & Karso, 2020). Many countries in the world have become developed countries because of the progress of the country's education. Nielsen

(2019) reveals that one of the factors for the progress of a nation and a country is the progress of the nation's and state's education. One of the countries in question is Sakura Country, Japan. This country was destroyed after losing the second World War in 1945. After that defeat, Japan became one of the most developed countries in mainland Asia. One way for them to become a developed country is to improve the quality of their education.

Currently, improving the quality of education is a mandatory thing that must be done in order to improve the quality of education when reflecting on the countries above. In line with this statement, Ruck (2020) stated that improving the quality of education is a mandatory thing that must be done to improve the standard of living of a nation. Furthermore, Morgan & Stewart (2019) revealed that improving the quality of education is one of the keys that a country must have if it wants to become a developed country. Thus, improving the quality of education is something that must be done for the progress of a nation.

There are many components in education that must be understood and considered in order to improve the quality of education. One way to improve the quality of education is to develop and improve components in education and learning (Muhayani & Fatmariza, 2022; Nixon et al., 2019). The components referred to are learning tools as tools in carrying out the teaching and learning process in class which include syllabus, lesson plans, learning objectives, models, methods, strategies, approaches and so on. In addition, other components that are also very important are teachers as users of learning tools and as executors and main actors in the world of education (Bradley-Levine, 2022; Figueredo-Canosa et al., 2020; Sawalhi & Chaaban, 2022).

As the main actor in education, the teacher is an important component that can have a direct influence on the abilities and skills of students. This is because teachers directly guide students (Meyers et al., 2019; Shurr et al., 2022). Thus, every teacher needs to understand the tools he uses in carrying out each learning process in the classroom. This is because the tools they use are one of the keys to the success of the learning process (Musselwhite & Wesolowski, 2018; Samoylenko et al., 2022). Furthermore, Sawyer et al. (2020) said that teachers must be able to create a pleasant learning atmosphere for students to be able to take part in the learning process without any pressure.

Mathematics is a compulsory subject at every level of education (Saenz et al., 2023), including at the elementary school level (Kaskens et al., 2022). However, in reality, many students have difficulty learning and understanding this subject (Li et al., 2020). If studied properly, it will be found that mathematics is a science that is very useful in everyday life for every human being (Charatchaiwanna et al., 2019). Therefore, it can be said that mathematics is very important for students to understand and master as a preparation for solving all problems related to mathematics in everyday life.

Mathematics at the elementary school level has material that must be delivered well and correctly by every educator (Kaya & Karakoc, 2022). This is because the mathematics material in elementary schools is abstract, so every educator needs to make the material as real as possible so that students can understand the mathematics material well (Barnes & Stephens, 2019). Therefore, teachers need an appropriate learning model to teach elementary school mathematics material.

One of the materials studied in mathematics in elementary school is fractions. This material is important material for students to understand and master (Perry, 2023) including students in elementary schools (Resnick et al., 2023). This is because students will always encounter fractions in their daily lives (Karika & Csikos, 2022) such as dividing pizza into

several parts, dividing an apple into several parts, and so on. By understanding fractions, students will also understand what remains of pizza if $\frac{2}{8}$ of the pizza has been eaten.

Understanding fractions is a must for a student (Tian et al., 2021). By understanding fractions, students will have no difficulty in solving problems they encounter related to fractions (Tran-Duong, 2021). However, in several studies such as multiplication of fractions (Purnomo et al., 2022), students' understanding of fractions (Murtiyasa & Vivin, 2020), fractions at elementary schools (Primasari et al., 2021), and addition of fractions (Saparwadi, 2022), it was found that fractions are material that is difficult for students in elementary school to understand.

Students' difficulty in understanding fractions is a sign that students have low mathematical understanding abilities. Mathematical understanding ability is one of the mathematical abilities that help students understand concepts, principles, and relationships in mathematics (Ivars et al., 2020). This ability is the basis of all mathematical abilities (Yao et al., 2021) which have an important role in students' daily lives (Rohaeti et al., 2023) including students at elementary school (Bevan & Capraro, 2021).

The ability to understand mathematics will help students solve every problem they face (Gunesch, 2021) including fraction problems (Sevier et al., 2022). Fractions are one of the mathematical materials that students consider difficult. Therefore, the ability to understand mathematics is an ability that students must have to solve various problems regarding fractions. Based on research (Agustini & Pujiastuti, 2020), (Yani et al., 2019), (Kusnadi et al., 2021), dan (Khairunnisa et al., 2022), it was found that students' ability to understand mathematics is still low. Therefore, a learning model is needed to improve students' ability to understand mathematics, especially fractions.

In the 21st century, students' ability to understand mathematics is very important (Akay et al., 2022). This is because competition in this century is so tight that educators need the right learning model to improve students' mathematical understanding. Several models recommended for improving students' mathematical understanding in the 21st century include Discovery Learning, Inquiry Learning, Problem-Based Learning, and Project-Based Learning (Rahmawati, 2022). These models are considered capable of improving students' mathematical understanding in the 21st century.

Discovery Learning is a learning model put forward by one of the education experts in 1967, namely Jerome Bruner (Usman et al., 2022). Bruner's thinking about this learning model is that each student must find their own solution to a problem (Sawah & Kusaka, 2023). Bruner believes that discovery-based learning will provide students with great memory and also support students' ability to carry out investigations (Zahara et al., 2020). This is also based on the finding that student involvement is more important than teacher explanation. In the process, Bruner emphasizes the active participation of each student in solving problems (Sulistyo et al., 2022). This shows that this model also requires the active participation of students in the learning process.

The discovery learning model requires students to participate actively in the learning process. This allows students to explore their abilities and skills to the maximum level which allows students' mathematical abilities to increase (Hariyanto et al., 2022). Through this model, students are required to discover their own knowledge (Zahara et al., 2020) which strengthens students' mathematical abilities (Syawaludin et al., 2022). Besides, the learning process will be more meaningful for students through this learning model. This is because this learning model emphasizes the discovery process (Hajian et al., 2021).

Basically, the discovery learning model has been used in various research in education, especially in Indonesia. These studies include integrated learning in Payakumbuh City (Marisya & Sukma, 2020), increasing motivation and learning outcomes in Depok City (Sulfemi & Yuliana, 2019), problem-solving at State Senior High School 1 Pagaran (Simamora et al., 2019), increasing student activity and science learning outcomes in Karangtengah (Sispariyanto et al., 2019), action research of integrated thematic learning in Limo Koto (Indra & Lena, 2023), and student metacognition in preparing lesson plans in Jakarta (Jannah et al., 2022). However, of all these studies, there has been no research on increasing students' mathematical understanding through discovery learning for coastal students. In the end, this study aims to determine the effectiveness of this model in improving coastal students' mathematical understanding.

Research Method

The method used in this study was a pre-experimental design where this study used students in one class, namely the experimental class without the control class (Cheng et al., 2021). There are several types of pre-experiment designs, one of which is the one-group pre-test and post-test which in practice, it is just conducted in one class with two tests (Afacan & Gürel, 2019).

Table 1. Application of pre-experiment

Subject	Pre-test	Implementation	Post-test
4 th Grade Students	X	O	X

This research was conducted at SDN 111 Buton, Talaga Baru Village, Lasalimu District, Buton Regency, Southeast Sulawesi. This research involved 28 grade 4 elementary school students. The data collection tool in this research was a test given before implementing the discovery learning model and after implementing the model. The research began by giving a pretest to students to determine the students' initial abilities. After conducting the pretest, students received material about fractions by implementing the discovery learning model. The implementation of this model was conducted by following the school's schedule, namely 4 meetings. After implementing the model, students were given fraction questions to complete as a posttest. This was done in order to determine the effectiveness of the discovery learning model.

The data obtained by researchers was processed using the SPSS version 25 application to determine differences in students' mathematical understanding abilities before and after implementing the discovery learning model. Besides, researchers also used the Microsoft Excel application to compare the average students' mathematical understanding abilities before and after implementing this model. Data that has been processed using the SPSS version 25 and Microsoft Excel applications was analyzed by researchers to find out whether the discovery learning model was effective in improving students' mathematical understanding abilities or not. Based on the results of this analysis, researchers will conclude the final results of whether the discovery learning model was effective in improving students' mathematical understanding abilities or not.

Result and Discussion

The test was conducted twice, namely the pretest and posttest. Next, the researcher tested the data that had been collected using a statistical application, namely SPSS version 25. After the researcher tested the data, the researcher then analyzed the results of the test and described the results of the data test.

In the first step, the researcher conducted a normality test on the data that the researcher collected with $\alpha = 0.05$. The normality test hypothesis is as follows:

H_0 : the data is normally distributed

H_1 : the data is not normally distributed

The normality test results can be seen in table 2 below.

Table 2. Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
pretest	0.112	28	.200*	0.946	28	0.155
posttest	0.120	28	.200*	0.946	28	0.155

Based on the results of the normality test on the pretest and posttest data, it appears that the significance of the normality test of the data is 0,155. Thus, it can be concluded that the data is normally distributed. Once it is known that the data collected by the researcher is normally distributed, the next step is to test the homogeneity of the two data with $\alpha= 0.05$. The homogeneity test hypothesis for the two data is as follows:

H_0 : data is distributed as homogeneous

H_1 : the data is not distributed homogeneously

The results of the homogeneity test of the two data can be seen in Table 3 below.

Table 3. Test of Homogeneity of Variances

		Test of Homogeneity of Variances				
		Levene	df1	df2	Sig.	
Statistic						
Hasil Belajar	Based on Mean	4.700	1	54	0.035	
	Based on Median	4.762	1	54	0.033	
	Based on Median and with adjusted df	4.762	1	37.958	0.035	
	Based on trimmed mean	4.677	1	54	0.035	

Based on Table 2 above, it can be seen that the significance of the data is smaller than α . By looking at the results of the homogeneity test, it can be seen that H_0 is rejected, and H_1 is accepted, so it can be concluded that the data is not homogeneous. Once it is known that the data is not homogeneous, the next step is to test whether there is a mean difference between the pretest and posttest using the two-tailed Mann-Whitney U test with $\alpha= 0.05$. The Mann-Whitney U test hypothesis is as follows:

H_0 : there is no mean difference between the pretest and posttest ($\mu_1=\mu_2$).

H_1 : there is a mean difference between the pretest and posttest ($\mu_1\neq\mu_2$).

The results of the two-tailed Mann-Whitney U test from the two data can be seen in Table 4 below.

Table 4. Test of Mann Whitney U

Test Statistics ^a	
	Hasil Belajar
Mann-Whitney U	10.000
Wilcoxon W	416.000
Z	-6.265
Asymp. Sig. (2-tailed)	0.000

Based on the results of the two-tailed Mann-Whitney U test above, it can be seen that the significance of the data is 0.00, which means that the statistical hypothesis ($\mu_1 = \mu_2$) is rejected, and the research hypothesis ($\mu_1 \neq \mu_2$) is accepted. Thus, it can be concluded that there is a mean difference between the pretest and posttest of students.

Mathematical understanding ability is the ability of students to understand and apply mathematics in everyday life, both in the school environment and outside the school environment. Afgani et al. (2019) stated that mathematical understanding ability is the ability to use mathematics as a means to solve every problem encountered in everyday life.

Based on the findings above, the researcher found that one way that can be used to improve students' mathematical abilities is to use the discovery learning model in the process of learning mathematics. This model can be a tool for teachers to improve students' mathematical understanding abilities (Albright & Beussman, 2017; Dina et al., 2019; Murat & Leman, 2020). This is because this model will involve students directly in every teaching and learning process both inside and outside the classroom.

In addition to using the SPSS application, researchers also used the Microsoft Excel application to find out for sure the differences in the average mathematical understanding ability of students before getting the discovery learning model (pretest) and after the discovery learning model (posttest).

Table 5. Average of the pretest dan posttest

	Pretest	Posttest
Average	64.43	90.46

Based on the results of the average calculation, it can be seen that the students' mathematical understanding ability after getting the discovery learning model increased by 40.4%. Thus, it can be concluded that students' mathematical understanding ability can be improved by using the discovery learning model.

As one of the recommended models for use in the 21st century, the discovery learning model can help students find something meaningful in every learning process. This is because this model will involve students directly in the learning process by providing examples of a problem to them (Nahdi, 2018; Sispariyanto et al., 2019). These problems will be identified by students to be further solved by collecting as much information as possible and processing this information into a solution. Solutions made by students will be used as student findings. In turn, students will be asked to generalize their findings using written sentences appropriately. In addition, this model provides opportunities for students to be directly involved in each learning

process and will help students find the meaning of learning (Kariman et al., 2019; Martin & Wilson, 2017).

Conclusion

Based on the discussion above, it can be concluded that mathematical understanding ability is important for every human being, including students. Every student needs to improve their mathematical understanding ability. In this study, researchers concluded that the discovery learning model can improve students' mathematical understanding ability. Mathematical understanding ability is very useful in the daily life of students. The conclusions of this study can be considered by educational practitioners (teachers) in carrying out the teaching and learning process by taking into account aspects of the findings in this study.

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