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Improving Mathematical Understanding Ability Using Tournament Learning with the Help of Panta Media

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Abstract

Students' understanding of mathematical concepts is still relatively low, especially in data material. One of them is caused by the learning process which is still student-centered. So this research aims to find out how to increase student's ability to understand mathematical concepts using tournament-based learning with the help of panta media. This type of research is quasi-experimental with a nonequivalent control group research design. The population used was class V students in North Sumedang District with research samples from class V at SDN Sindang II as the experimental class and SDN Jatihurip as the control class. The instrument used is a test of the ability to understand mathematical concepts with description questions. The analysis technique in this research is the mean difference test (paired sample t-test and independent sample t-test) which has been tested for normality and homogeneity. To determine the increase in students' mathematical abilities, the N-Gain test was carried out. The two classes were given different treatments, namely the experimental class with tournament-based learning assisted by panta media and the control class with conventional learning. The increase in students' ability to understand mathematical concepts can be seen from the average N-Gain results in the experimental class of 0.6500 in the moderate improvement category and in the control class of 0.2591 which is classified as low improvement. The two classes have significant differences in their ability to understand mathematical concepts. It was concluded that tournament-based learning with the help of panta media can improve students' understanding of mathematical concepts.

Keywords: Mathematical Understanding Ability, Tournament Learning, Panta Media.

1. Introduction

Education is the most important thing in every individual's life to improve their quality and potential. Mathematics is one of the many fields of study that has an important role in the world of education. Mathematics is also a universal science that underlies modern technological progress. Mathematics is a subject taught at all levels of education and is no less important than other sciences. Thus, mathematics is a basic science whose implementation is very necessary for science and technology (Padahala et al., 2021).

In practice, many students think that learning mathematics is a boring activity, and the material is complicated for them to understand (Ditasona, Kartika, & Lumbantoruan, 2022). Apart from that, many students also think that mathematics is a lesson that cannot be separated from calculations and numbers which makes them bored, tired, and difficult to learn (Rizkyani & Amelia, 2020). Based on this assumption, can hinder students from wanting to

study mathematics. In elementary school mathematics learning, regarding data presentation material, there are still many students who experience difficulty in presenting data. This is because many students are silent if they do not understand the concept of the material, but there are still many students who chat with friends while learning is taking place (Arifin et al., 2020).

Understanding concepts is one of the skills needed to convey back the knowledge gained so that other people who acquire the knowledge understand what is conveyed both orally and in writing. This is in line with Maulana's opinion (dalam Ani et al., 2017) which states that the initial stage of high-level thinking is about understanding mathematics, when students understand, they will be able to solve problems and communicate them. Based on the results of observations at one of the elementary schools in Sumedang Regency, namely SDN Sindang II, the researcher found a problem that occurred in class V in the material of data collection and presentation, namely that students did not understand the concept of data collection and presentation, this was shown by the fact that there were still many students who feel confused when grouping the data obtained. Apart from that, another problem is indicated by students' confusion when presenting data in the form of a bar chart, especially when the data obtained has many different frequencies.

In general, the mathematics learning process in this class uses conventional learning carried out by lectures by the teacher. In this case, teachers still play an integral role in the teaching and learning process, resulting in a lack of opportunities for teachers to collaborate with students in learning. This is the opinion of Purnomo et al. (2018) regarding conventional learning explains that conventional learning focuses more on the teacher's task of giving instructions or lectures during the teaching and learning process, while students only receive learning passively. Students who find it difficult to collect and present data tend to be due to the learning process being carried out passively, students not actively participating in the learning process (Natalia, Manalu, & Purba, 2021);(Kristin, Ditasona, & Lumbantoruan, 2021). This is due to a lack of motivation within students to want to learn and a lack of sense of challenge when learning. Apart from that, the teaching and learning process seems monotonous because in its implementation the teacher only uses textbooks, without using learning media.

One way that can be done is by applying learning models and media to make the mathematics teaching and learning process interesting. Media is an unsaparablel part from teaching and learning process and methods (Lumbantoruan & Natalia, 2021). Researchers chose a learning model as an alternative to overcome this problem, namely by implementing a cooperative learning model. Cooperative learning is a learning model that is characterized by interaction between students when discussing ideas or concepts (Isrok'atun & Rosmala, 2018). Cooperative learning is a model that can be applied in the classroom because students are made the center of learning to develop mathematical abilities (Mallini, Purba, & Sihotang, 2023). The learning carried out in this research is tournament-based learning or in other words Teams Games Tournament. Apart from applying learning models, overcoming these problems can be done by using media that can make it easier for students to understand the material. One learning media that can make it easier for students to understand material related to data presentation is panta media. Panta Media (papan data) is a tool used to make it easier for teachers to convey material related to data presentation. Panta media is made from styrofoam, cardboard, ribbon, push pins, mica, cards containing data and frequencies, and printed decorations. With this panta media, it helps students to present data, especially in the form of bar charts by placing bands that are adjusted to the frequency of the data obtained.

Based on the background of the problem that has been explained, an alternative to this problem is implementing a tournament-based learning model with the help of panta media to increase the conceptual understanding of class V students at one of the State Elementary Schools in Sumedang Regency. Therefore, this research is entitled "Improving Mathematical Understanding Ability Using Tournament Learning with the Help of Panta Media".

2. Methods

This research uses using experimental method. The form of research design used is quasi-experimental. The researcher used a quasi-experiment because, in reality, the researcher cannot fully control external variables such as economics, family, parents, and so on (Pratiwi, Manullang, & Ditasona, 2021). Then in this study, a nonequivalent control group design was applied. Using two classes, namely the experimental class and the control class. In the experimental class, a tournament-based learning model is applied with the help of panta media (papan data), and in the control class, conventional learning is used. The design of this research is based on opinion (Sugiyono, 2013).

Table 1. Research Design

Group	*Pretest*	*Treatment*	*Post-test*
Experiment	O_1	X	O_2
Control	O_3	-	O_4

Information:
O_1= Pretest (test before carrying out tournament-based learning with the help of panta media)
O_2 = Post-test (test after carrying out tournament-based learning with the help of panta media)
X= Treat (tournament-based learning with the help of panta media)
O_3= Pretest (test before using conventional learning)
O_4= Post-test (test after using conventional learning)

The research population was fifth-grade elementary school students in North Sumedang District. The subjects of this research, namely samples that meet the requirements and represent the population, can be selected as research subjects using purposive sampling techniques. Thus, the sample in this study was class V students at SDN Sindang II and SDN Jatihurip. At SDN Sindang II the sample chosen was class V-A with a total of 30 students who were used as an experimental class using a tournament-based learning model with the help of panta media. Meanwhile, for SDN Jatihurip, the sample chosen was class V-A with a total of 29 students which was used as a control class using a conventional learning model. The instrument in this research is a test carried out to measure mathematical understanding abilities in the form of essay questions. There are 8 questions for the pretest and there are also 8 questions for the post-test, with the same questions but made out of sequence between the pretest and post-test.

Instrument validity is carried out through expert judgment and empirical validity as well as conducting instrument trials on students which are then tested for validity and reliability. The inferential statistical test uses SPSS version 27 software using (prerequisite tests: normality test and homogeneity test) followed by hypothesis testing, namely the Paired Sample T-test and the Independent test, which is data analysis carried out by researchers. After the researcher carried out the hypothesis test, they continued with the N-gain test to ascertain

whether the treatment in the experimental class had improved students' mathematical understanding abilities in data collection and presentation material.

3. Result and Discussion

This research was conducted from March to May 2024 with class V students at SDN Sindang II as the experimental class and SDN Jatihurip as the control class. Data obtained from the pretest and post-test results of students' mathematical understanding abilities in both the experimental class and control class will be explained in more depth in this section.

Table 2. Average for each class

Data Group		*N*	*mean*	*Std. Deviation*	*Variance*
Control Class	*Pretest*	29	59,40	18,312	335,346
	Posttest	29	51,43	12,621	159,278
Experimental Class	*Pretest*	30	71,28	14,326	374,875
	Posttest	30	81,53	19,362	205,223

Based on the results of the students' pretest and posttest, the averages obtained in the control class were 59.40 and 71.28, which can be seen in Table 2. This shows that there is an average difference between the pretest and posttest of 11.88, whereas in the experimental class students experienced an average increase in mathematical understanding ability of 30.11. The pretest and post-test data were then tested for normality using SPSS 27 as shown in Table 3.

Table 3. Control class normality test

Data Group		Statistic.	df	Sig.
Control Class	*Pretest*	0,903	29	0,012
	Posttest	0,942	29	0,112

The normality test used is Shapiro Wilk because the data is small or less than 50. Table 3 shows that the pretest results in the control class are not normally distributed because they have a significance level of 0.012 < 0.05. Meanwhile, the post-test results are normally distributed because they have a significance level of 0.112 > 0.05. Thus, the data distribution in the control class is not normally distributed. Then there is no need to carry out a homogeneity test because the samples are connected, namely the pretest and post-test in the control class. Once it is known that the data is not normally distributed, the next test is the mean difference test using Wilcoxon to see the difference between the two.

Table 4. Control class Wilcoxon test results

Test Statistics[a]	
	Posttest -Pretest
Z	-4,304[b]
Asymp. Sig (2-tailed)	.000

H_0: There is no difference in conventional learning in the ability to understand mathematical concepts

H_1: There are differences between conventional learning and the ability to understand mathematical concepts

With the following test criteria:
If sig < 0.05 then hypothesis H_0 is rejected and H_1 is accepted
If sig ≥ 0.05 then hypothesis H_1 is rejected and H_0 is accepted

Table 4 shows that the sig value is 0.000, which means <0.05, so the pretest and post-test results in the control class show a significant difference. This shows that there is a difference in the increase in student's conceptual understanding abilities that occurred in the control class.

Based on Table 2 above, the experimental class shows the students' pretest and post-test results with an average score of 51.43 and 81.53, so the difference between the pretest and post-test averages is 30.1. Then a normality test was carried out on the two data using SPSS 27 as follows

Tabel 5. Experimental class normality test

Data Group		Statistic.	df	Sig.
Experimental Class	*Pretest*	0,946	30	0,128
	Posttest	0,908	30	0,013

The results of the normality test in the experimental class are based on Table 6, the pretest value shows a significance level of 0.128 > 0.05, meaning the data is normally distributed. Meanwhile, the post-test results have a significance level of 0.013 <0.05, so the data is not normally distributed. Thus, the data distribution in the experimental class is not normally distributed. Because the pretest and post-test data samples in the experimental class have bound samples, there is no need to carry out a homogeneity test. As with the control class, the next test is the mean difference test using the Wilcoxon test as in Table 6.

Tabel 6. Experimental class Wilcoxon test results

Test Statistics[a]	
	Postest -Pretest
Z	-4,784[b]
Asymp. Sig (2-tailed)	.000

H_0: There is no difference in tournament-based learning with the help of panta media on the ability to understand mathematical concepts.
H_1: There is a difference in tournament-based learning with the help of panta media on the ability to understand mathematical concepts.

With the following test criteria:
If sig < 0.05 then hypothesis H_0 is rejected and H_1 is accepted
If sig ≥ 0.05 then hypothesis H_1 is rejected and H_0 is accepted

The results of the pretest and post-test in class based on Table 6 show that there is a significant difference, indicated by the sig value of 0.000, which means <0.05. It can be concluded that there is a difference in the increase in students' ability to understand concepts that occurs in the experimental class. After that, the gain calculation is carried out to find out how much increase has occurred using the help of SPSS 27.

Because both are significant differences between the pretest and post-test, both the control class and the experimental class. So in each class, there will be an increase in the ability to understand mathematical concepts. Researchers looked for how much improvement in the ability to understand mathematical concepts between the control class and the experimental class by using the gain test (Meltzer, 2002) as follows.

$$gain = \frac{Posttest\ score - Pretest\ score}{maximum\ possible\ score - pretest\ score}$$

Next, the gain value is obtained from each student in the control and experimental classes which is calculated based on the formula above. After obtaining the calculation results, to find out the gain criteria obtained by each student whether they are classified as low, medium, or high according to (Hake, 1999) the gain value criteria are as in Table 7.

Table 7. N-Gain value criteria

Value	Category
(<g>) >0,7	High
0,7> (<g>) >0,3	Medium
(<g>) < 0,3	low

Tabel 8. Recapitulation of the N-Gain test in the control class

Student	N-Gain Value	Category	Student	N-Gain Value	Category
1	0,15	Low	16	0,30	Medium
2	1,00	High	17	0,55	Medium
3	0,13	Low	18	0,42	Medium
4	0,00	Not Increasing	19	0,26	Low Low
5	0,22	Low	20	0,06	Medium
6	-0,03	Decrease	21	0,36	Low
7	0,53	Medium	22	0,23	Low
8	0,03	Low	23	-0,14	Decrease
9	0,30	Medium	24	0,48	Medium
10	0,00	Not Increasing	25	0,43	Low
11	0,38	Medium	26	0,16	Low
12	0,07	Low	27	0,09	Low
13	0,54	Medium	28	0,25	Low
14	0,25	Low	29	0,27	
15	0,21	Low			

Based on the table above, it shows that 14 students achieved low improvement, 10 students had medium improvement, 1 student was classified as high improvement, 2 students did not experience improvement, and 2 students experienced a decrease in their ability to understand concepts in data collection and presentation material.

Table 9. Average gain results in the control class

Class	*N*	*Minimum*	*Maximum*	*Mean*	Category
Control	30	0,10	1,00	0,2591	Low

The results of the gain calculation show an average increase of 0.2591 in the control class. With a minimum gain of -0.14, it shows that there are students who experience a decline in

mathematical understanding abilities and students who experience a maximum increase with a gain of 1.00. The average increase is classified as a low increase.

Table 10. N-Gain test results in the experimental class

Student	N-Gain value	Category	Student	N-Gain value	Category
1	0,86	High	16	0,78	High
2	1,00	High	17	0,73	High
3	0,67	Medium	18	0,74	High
4	0,75	High	19	0,77	High
5	0,23	Low	20	0,40	Medium
6	0,95	High	21	0,60	Medium
7	0,65	Medium	22	0,87	High
8	0,45	Medium	23	0,54	Medium
9	0,70	Medium	24	0,82	High
10	0,52	Medium	25	0,10	Low
11	0,95	High	26	0,50	Medium
12	0,58	Medium	27	0,76	High
13	0,54	Medium	28	0,80	High
14	0,76	High	29	0,52	Medium
15	0,59	Medium	30	0,32	Medium

There were 2 students classified as low improvement, 14 students classified as medium improvement, and 14 students classified as high improvement in their ability to understand concepts in data collection and presentation material. It can be said that tournament-based learning with the help of media achieved better improvements compared to the control class, as seen from the N-Gain results for each student in the control class and the experimental class.

Table 11. N-Gain test results in the experimental class

Class	*N*	*Minimum*	*Maximum*	*Mean*	Category
Experimental	30	0,10	1,00	0,6500	Medium

The average increase in gain calculation results in the experimental class was 0.6500, which is classified as a medium increase. Based on Table 10, in contrast to the control class, in the experimental class, there were no students who experienced a decline in mathematical understanding abilities. Because the minimum gain obtained is 0.10 including low increases. Likewise, in the control class, some students experienced maximum improvement with a gain of 1.00, classified as high improvement.

Table 12. Recapitulation of the normality test of student N-Gain data

Data Group	Statistic.	df	Sig.
N-Gain control class	0,940	29	0,103
N-Gain experimental class	0,965	30	0,418

Table 13. Homogeneity test results

Homogeneity test	
F	*Sig.*

0,012	0,912

Table 14. Independent sample test results

Independent Sample Test		
t	df	Sig. (2-tailed)
-6,777	57	< 0,000
-6,765	55,967	< 0,000

The analysis results in Table 12 show that the N-Gain significance value in the control class is 0.103 and 0.418 in the experimental class so the N-Gain for both classes is normally distributed because the significance value exceeds the alpha value, namely 0.05. Then a homogeneity test was carried out with the test results listed in Table 13, the results of the analysis showed that the sig value was 0.912, which means that the N-Gain variant of the control class implemented conventional learning with the experimental class implementing tournament-based learning assisted by panta media had the same variant so that the N-Gain data the control class and experimental class are homogeneous data. Thus, the analysis of the data obtained is that the data is normally distributed and homogeneous, then a mean difference test (Independent Sample T-Test) is carried out to see the difference between the two.

The results of the mean difference test can be seen in Table 14. The results show a sig value of 0.000, which means <0.05, so the H_1 hypothesis is accepted and the H_0 hypothesis is rejected because the significance value obtained is smaller than the alpha value. Thus, it is clear that there is a significant difference between the increase in N-Gain in the control and experimental classes. The initial condition of the control class is that it has a greater average value than the experimental class which can be seen in table 2. However, after being given treatment in the experimental class, namely tournament-based learning with the help of panta media and conventional learning in the control class, the results of data processing using the Independent Sample T-Test test, namely the hypothesis H_0 is rejected, meaning there is a significant difference in scores between classes that implement tournament-based learning with the help of panta media and conventional learning. The test results show that there are significant differences in students' ability to understand mathematical concepts in data collection and presentation material. The difference in the ability to understand the concept can be seen from the increase in the N-Gain scores of students in the two classes.

The differences in treatment given to each class led to differences in increasing students' ability to understand mathematical concepts. This is proven by the difference in the increase in students' mathematical understanding ability with the average post-test score between the class with tournament learning assisted by Panta media, namely 81.53 and the average for the class with conventional learning of 71.28 which is also supported by the test results. N-Gain shows that the experimental class experienced an increase in the medium category while the control class had a low increase (tables 9 and 11). By implementing tournament-based learning, it is able to create an effective learning climate in the classroom, because students are encouraged to play a more active role in the learning process and constantly receive encouragement that is able to explain understanding of the concepts being studied (Annurwanda, 2018). Pengimplementasian model pembelajaran berbasis turnamen ini mampu menciptakan kelompok belajar siswa yang saling bekerja sama dalam sebuah tim. Implementing this tournament-based learning model is able to create learning groups of

students who work together as a team. Thus, each member of the group has the responsibility to ensure that other members achieve the goal, namely understanding the lesson and mastering it well (Sudarsana, 2018).

In tournament-based learning, each group member plays a tournament with other group members who have almost the same level of intelligence. For the success of the tournament, each group member gets a score. Thus, each group member is required to be able to understand a concept being taught to contribute to obtaining a group score. The tournament-based learning steps applied in this research are according to (Ermilia, 2015) which states that the tournament-based learning model has four stages for the learning process to take place. Four stages of the tournament-based learning model including,

(1) Presentation in class

Figure 1. Presentation in class

Class presentations are learning activities in delivering material either directly or in discussions guided by a teacher. Based on Figure 1, the presentation in this class is the initial stage where the teacher explains the learning objectives and the activity steps that will be carried out in the future by students.

(2) Study Group

Figure 2. Study group

The groups formed in this learning model are seen from the student's academic abilities, namely groups with high, medium, and low academics consisting of 5 people as seen in Figure 2. The formation of groups like this has the aim of ensuring that each member of the group is true -Really when studying, preparing, and supporting group members when answering a tournament question.

(3) Tournament

Figure 3. Tournament Activities

The tournament referred to in the tournament-based learning model takes place in a game or competition for each group. As in Figure 3, this tournament is carried out by dividing students into several tournament tables, then students answer the tournament questions displayed by the projector on the paper provided and are given 1 minute. Each group member plays a match at a different tournament table. Students who have almost the same academic ability from each group sit at the same table to carry out the tournament. Next, the tournament points from each group member are accumulated into group points. Thus, each group member competes to get as many points as possible.

(4) Awarding

Groups that get points according to certain criteria will receive an award, either in the form of a certificate, food, or other awards as in Figure 4. The awards given are important to explain that the success obtained is the success of each member of the group.

Figure 4. Awarding

The learning media used can also make it easier for students to understand learning, especially in presenting data using bar charts. This is in line with the opinion of Fadilah et al. (2023) who stated that learning media is a tool that is used to maximize and increase the effectiveness of learning. Because panta media is concrete media that can be used directly by students so that students have real learning experiences. Apart from that, the panta media in this research was made according to the number of groups in the class so that it was ensured that every student could practice it.

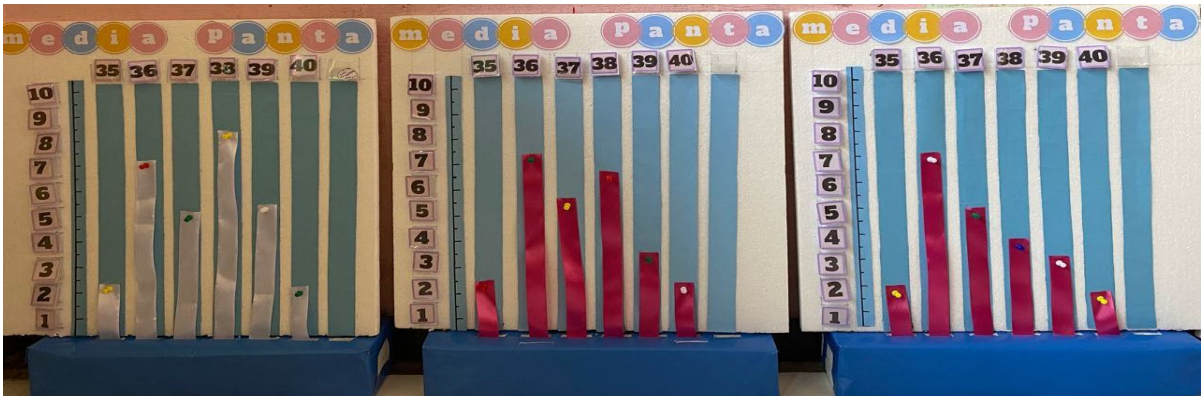

Figure 5. Panta media (Papan Data)

The form of panta media in this research is shown in Figure 5. Panta media is made from styrofoam, cardboard, ribbon, push pins, mica, cards containing data and frequencies, and printed decorations. The way to use panta media is to insert frequency cards into the mica in vertical order, and then insert the cards containing known data into the mica in horizontal order. The final step is to pull the tape according to the existing data and frequency with the help of a tuspin, do this until all the data is displayed on the tape diagram.

Meanwhile, the learning applied in the control class is conventional learning in teaching and learning activities. Conventional learning patterns focus on the transfer of information from teacher to student. In line with the opinion of Fahrudin et al. (2021) stated that what is meant by conventional learning is teacher-centered learning, meaning that the teaching and learning process is carried out monotonously and verbally, in other words delivering the material still in the form of lectures. In the conventional learning paradigm, the main goal of educators is to provide complete knowledge to their students. The conventional learning model focuses on the teacher's task of providing lectures or directions in the learning process. In the conventional learning model, students only gain knowledge passively from the teacher, who is responsible for providing direction in front of the class, resulting in a lack of interaction in the learning process between students and students, teacher and students, and so on.

4. Conclusion

From the research results that have been explained, it can be concluded that there is a significant difference between the ability to understand mathematical concepts of students who learn by applying tournament-based learning assisted by panta media and students who learn by applying conventional learning. The calculation results of the increase in the ability to understand mathematical concepts obtained from the N-Gain test in the experimental class have an average of 0.6500 which is classified as a medium increase. Meanwhile, 0.2591 is an increase in the control class which is classified as a low increase. Judging from the average of the N-Gain test, the experimental class with tournament-based learning assisted by pata media is superior to the control class with conventional learning. In this way, tournament-based learning assisted by panta media can create student cooperation in groups during the learning process. The creation of good cooperation is a supporting factor for students to be able to understand the material being taught so that it will also improve students' mathematical understanding, especially in data collection and presentation material.

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