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THE EFFECT OF USING NAPIER STEM MEDIA ON STUDENTS' UNDERSTANDING OF MATHEMATICAL CONCEPTS

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ABSTRACT

Tujuan penelitian ini adalah untuk mengetahui pengaruh media batang napier terhadap pemahaman konsep kelas III SD Negeri 020252 Binjai. Jenis penelitian ini adalah kuantitatif. Subyek penelitiannya adalah seluruh siswa kelas IIIA dan IIIB SD Negeri 020252 Binjai. Teknik pengambilan sampel pada penelitian ini menggunakan purposive sampling. Sampel dalam penelitian ini berjumlah 44 siswa dengan mengambil 2 kelas yaitu kelas eksperiment dan kelas control kelas eksperiment berjumlah 22 dan kelas kontrol berjumlah 22 siswa. Instrument penelitian ini menggunakan tes. Teknik analisis data meliputi uji validitas, uji reliabilitas, uji normalitas, uji homogenitas, uji n - gain dan uji hipotesis. Hasil penelitian menunjukkan bahwa media batang napier berpengaruh terhadap kemampuan pemahaman konsep siswa karena pada hasil analisis uji t (independent t-test) diperoleh dari hasil nilai signifikan (sig.2-tailed) 0.000< 0,05, maka Ha diterima dan H0 ditolah artinya terdapat pengaruh media battang napier terhadap pemahaman konsep siswa kelas III SD Negeri 020252 Binjai. Siswa yang mendapat perlakuan dengan menggunakan media batang napier memiliki rata-rata yang lebih tinggi jika dibandingkan tanpa menggunakan media batang napier Artinya variabel x (solusi) yang digunakan dalam penelitian mempengaruhi variabel y (masalah).

The purpose of this study was to determine the effect of napier rod media on the conceptual understanding of class III SD Negeri 020252 Binjai. This type of research is quantitative. The subjects of the study were all students of class IIIA and IIIB SD Negeri 020252 Binjai. The sampling technique in this study used purposive sampling. The sample in this study amounted to 44 students by taking 2 classes, namely the experimental class and the control class, the experimental class numbered 22 and the control class numbered 22 students. The research instrument used a test. Data analysis techniques include validity test, reliability test, normality test, homogeneity test, n-gain test and hypothesis test. The results showed that napier rod media had an effect on students' conceptual understanding abilities because the results of the t-test analysis (independent t-test) obtained from the results of the significant value (sig.2-tailed) 0.000 <0.05, then Ha was accepted and H0 was rejected, meaning that there was an effect of napier rod media on the conceptual understanding of class III students of SD Negeri 020252 Binjai. Students who received treatment using Napier rod media had a higher average when compared to those without using Napier rod media. This means that the variable x (solution) used in the study affects the variable y (problem).

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1. INTRODUCTION

Indonesia as a developing country, has currently implemented development in various fields. Through this development, it is hoped that Indonesia will be able to catch up with other developed countries. The progress of a nation or country itself can be seen from the quality of education of a country (Nurhuda, 2018:128). This is because if the education system in a country is strong, then the people or human resources of that country will be better prepared to face global challenges, trigger innovation, and actively contribute to economic and social development. Quality human resources will also be able to predict what will happen in the future, and realize what will be needed in the future (Rasyid, 2015:565). But in reality, the competitiveness of human resources in Indonesia is still lacking when compared to other countries, and one way to increase competitiveness is to improve the quality of our education (Hidayat, 2019:222). In the KBBI published by Balai Pustaka, it is explained that the word education comes from the basic word educate, which means to maintain and provide training (teachings, guidance, leadership) regarding morals and intelligence (Rahman et al., 2022:5).

Meanwhile, in the 1945 Constitution concerning the Education System No. 20 of 2003, it is stated that Education is "a conscious and planned effort to create a learning and teaching atmosphere so that students actively develop their potential to have spiritual religious strength, self-control, personality, intelligence, noble morals and the skills needed by themselves and society" (Ujud et al., 2023:7912). To improve the human resources capacity, mastery of basic sciences such as Mathematics is very important, because Mathematics is a tool that can be used to study various other disciplines.(Siagian, 2016:60). Almost all fields of science use Mathematical Concepts in studying their objects. Therefore, mastery of Mathematics is very necessary. The term mathematics itself comes from Greek, namely mathein or manthenien which means or means to study (Sugiyamti, 2018:176). Meanwhile, according to Sari (2016:20). Mathematics is a basic branch of science for the development of technology today, it plays an important role in various scientific disciplines, and improves human thought patterns. In line with the opinion above, Sukarwati (2017:34) also stated that mathematics is an important science because it will be studied at every level of education.

But in reality, many students, especially elementary school students, have difficulty understanding mathematics, even the simple parts (Lasmanah, 2020:47). This may be due to the abstract nature of the concept of learning mathematics. Thus, every abstract concept that is newly understood by students needs to be immediately reinforced so that it settles and lasts a long time in the students' memory and will stick in their thought patterns and action patterns (Mukminah et al., 2021:2). So it is not surprising that many people consider mathematics difficult to understand, especially for elementary school students, especially if the teacher only explains the subject matter without using interesting media. This conceptual error in mathematics can be caused by both teacher and student factors. The teacher factor is the teacher's lack of knowledge about mathematics. Teachers argue a lot about this problem, including lack of equipment, lack of understanding, and lack of social skills, which ultimately lead to inability and habits that are difficult to eliminate. In fact, there are still many teachers who deliver material only using the lecture method, making students passive and students just sit quietly listening and taking notes on abstract concepts (Nurliani, 2018:2). This condition is in line with the results of my observations in class III of SD 020252 Binjai. Where I have found several problems, namely more than 50%

of students in class IIIA and IIIB have difficulty in mathematics, especially multiplication operations.

Students also tend to memorize multiplication material without understanding the concept. For example 1 x 2 = 2, 1 x 3 = 3 and so on by memorizing. If this is done continuously, then when students are faced with other multiplication problems, students will experience difficulties. In addition. students also seem confused and less interested in participating in learning because teachers do not apply varied learning, and only use conventional media, namely printed books and whiteboards. It is realized that the lack of use of learning media will not be able to support the teaching and learning process in the classroom. This factor makes learning seem monotonous and less enjoyable. So that this is one of the causes of low understanding of student concepts in mathematics learning. According to Angely (2023:751) Learning media is an educational tool that can be used to help the teaching and learning process, as well as foster students' learning motivation, and everything that is used, both objects and the environment around students, that can be utilized by students in the learning process.

The presence of this media is certainly very important and depends on the purpose and content of the learning itself. Some of the benefits of media in learning are: the delivery of learning materials can be equalized, the learning process becomes more interesting, and the learning process becomes more interactive (Khoirina & Arsanti, 2022:995). Related to the problem above, the solution that can make it easier for students to improve their understanding of mathematical concepts in multiplication material is by using the "Napier Rod" media. This Napier Rod was first discovered by a Scottish nobleman named John Napier (1550-1617). According to Aristiani (2023:727) Napier rods are a learning tool for multiplication that turns multiplication problems into addition problems. The method of use involves looking at the numbers to be multiplied, then adding the numbers on the diagonal line. Retta (2019:524) states that this counting media is designed to simplify the difficult task of multiplication by changing multiplication into addition.

2. METHOD

In this study, the type of research used is Pretest Post Test Control Group Design. The purpose of this type of research is that there are 2 classes used for research. One class is used for the experiment (which is given treatment) and one for the control group (which is not given treatment) (Pratami et al., 2019:150). In this design, both groups are first given an initial test (pretest) with the same test. Then the experimental group is given special treatment, namely learning using napier rod media while the control group is given the usual treatment. After being given treatment, both groups are tested with the same test as the final test (posttest). The results of the two final tests are compared, as well as between the results of the initial test and the final test in each group.

Table 1. Pretest Post Test Control Group Design

Group	Pre Test	Treatment	Post Test
Experiment	O_1	X	O_2
Control	O_3		O_4

Information:
O_1 = experimental class was given a pretest
O_3 = control class was given a pretest.
X = Treatment is learning that uses Napier rod media
- = No treatment or lecture method is given
O_2 = post test in the experimental classjust given treatment
O_4 = posttest in the control class which was not treated

2.1. Research Subject

The population in this study were all students of SD 020252 Binjai. Due to limited time and funds, the technique used in determining the sample was the Purposive Sampling technique. Purposive sampling is a sampling technique used by researchers if researchers have certain considerations in taking samples or determining samples for certain purposes (Santina et al., 2021:5). The reason for using the Purposive Sampling technique is because not all samples have criteria that match the phenomenon being studied. Therefore, the author chose the Purposive Sampling technique which establishes certain considerations or criteria that must be met by the samples used in this study. Therefore, the sample obtained in this study were students of class IIIA and class IIIB of SD Negeri O2O252, each class having 22 students in the 2022/2023 Academic Year.

2.2. Data collection

The data collection technique used in this study is the test technique. The test technique is a data collection technique that is carried out by providing a series of questions or tasks and other tools to the subjects whose data is needed (Nasrudin, 2019:31). The test is used to distinguish between initial conditions and subsequent conditions (Sangadji, 2010:78). Tests help measure their understanding, knowledge and skills relevant to learning or research objectives (Fauziyah, 2023:6540). Questions in the test instrument can be in various forms, such as multiple choice, essay, short answer, or other types of questions. Data collection in this study used a test in the form of essay questions related to students' conceptual understanding abilities. Essay tests are tests that reflect the level of conceptual understanding and students' analytical and synthesis abilities. Through carefully designed questions, evaluation instruments can measure the extent to which students are able to apply knowledge in real contexts (Inayati et al., 2024:117). The test was conducted twice, namely before (pre-test) and after (post-test) with the information that the experimental class was given treatment.

2.2. Data analysis

The tests used to analyze the data include four types, namely instrument validity test, validity, reliability test, prerequisite test in the form of normality test and homogeneity test, N-Gain test and hypothesis test. First, instrument validity test, the technique used is to use Pearson Correlation or known as Product Moment Correlation. According to Sugiyono (2017;228), the product moment correlation coefficient is a correlation technique used to find relationships and prove the hypothesis of the relationship between two variables. This technique is intended to determine the suitability of the contents of the measuring instrument with the target to be measured concerning the test items of understanding the concept of Mathematics. The criteria for using the Product moment correlation are as follows (Indrawan & Dewi, 2020:82): if the result of rxy calculation is compared with rtable product moment, if rxy > rtable, then the question is declared valid. The following explains the interpretation of the correlation coefficient value rxy.

Table 2. Validity Criteria

No	rxy value	Interpretation
1.	0.80 < rxy ≤ 1.00	Very high
2.	0.60 < rxy ≤ 0.80	Tall
3.	0.40 < rxy ≤ 0.60	Enough
4.	0.20 < rxy ≤ 0.40	Low
5.	0.00 ≤ rxy < 0.20	Very Low

The second reliability test, this test is conducted on a questionnaire that has been declared valid. To find out whether a test item in this study is reliable or not, the reliability value is stated or analyzed using Cronbach Alpha (Hakiki, 2023:3088). A variable is said to be reliable if the Cronbach Alpha value > r table. Reliability testing is carried out using the following formula (Wahyuningsih, 2022:53). Where the interpretation of this reliability is as follows.

Table 3. Reliability Interpretation

No	r11 value	Interpretation
1.	0.80 < r11 ≤ 1.00	Very high
2.	0.60 < r11 ≤ 0.80	Tall
3.	0.40 < r11 ≤ 0.60	Currently
4.	0.20 < r11 ≤ 0.40	Low
5.	0.00 ≤ r11 < 0.20	Very Low

Third, the normality test is a test conducted to determine whether the data obtained is normal or not. The data is said to be normal if the significance level α = 0.05. In the normality test, the researcher will use the assistance of the IBM SPSS 25 application using the Shapiro Wilk technique. The decision-making for the normality test with Shapiro Wilk is as follows. If the significance value of the Shapiro Wilk test> 0.05, then H0 is accepted (indicating that the data is normally distributed). If the significance value of the Shapiro Wilk test <0.05, then H0 is accepted (indicating that the data is not normally distributed) (Santoso's stopover, 2010).

Fourth, the homogeneity test is a statistical method that aims to test whether the variance between two or more data groups is homogeneous or the same (Putri et al., 2023:566). In this study, the homogeneity test used is Homogeneity of Variances with calculations using IBM SPSS 25 (Education et al., 2020). The homogeneity test rules are as follows. If the significance value > 0.05, then H0 homogeneous variance is accepted (data is homogeneous). Conversely, if the significance value < 0.05 then Ha non-homogeneous variance is not accepted (data is non-homogeneous).

Fifth, the N-Gain test is a test used to see the difference in post-test and pre-test values of research.(Nismalasari et al., 2018:89). In the N-gain test, the average score of the initial data, namely the pretest and the final data score, namely the posttest, will be compared and tested for improvement. Where the criteria set if the calculated N-gain ≤ 0.3 then the improvement is low, if the calculated N-gain < 0.7 then the improvement is moderate, and if the calculated N-gain ≥ 0.7 then it can be concluded that the improvement is high (Kurniawan & Hidayah, 2020:94).

Sixth, hypothesis testing. Lolang (2014:693) states Hypothesis testing is an inferential process, which means that the hypothesis test uses a limited amount of information as a basis for obtaining general conclusions. In this study, there are two hypothesis tests used, namely parametric hypothesis and non-parametric hypothesis. If the data obtained is normally distributed, then the hypothesis test uses the Independent Sample T-Test. While if the data is not normally distributed. Decision making in the Wilcoxon test (Nurhalimah et al., 2020;193)

3. RESULTS AND DISCUSSION

3.1. Results

From the validity tests carried out, several instruments were found to be valid. The basis for decision making in the validity test is: if r count > r table then the item is valid. If r count < r table then the item is invalid (Anshari et al., 2024:965). With r table of 0.4227 (2-sided test with sig. 0.05) then the instrument or question items correlate significantly with the total score (declared valid)

Table 4. Results of Instrument Validity Test

Classification	Number of Question Items	Question Number
Valid	12	1, 2, 3, 4, 5, 6, 7, 10, 11, 12, 13, 14,
Invalid	3	8, 9, 15

Based on Table 4, it can be seen that there are 12 questions that are said to be valid from all questions for the concept understanding ability instrument. This is because the Rcount (Corrected Item-Total Correlation) value > Rtable of 0.4227; and sig <α; where α = 0.05

Next, a reliability test is carried out, where the instrument reliability coefficient is intended to see the consistency of the answers to the statement items, the reliability of which is then calculated using the "Cronbach Alpha" formula (Anggraini et al., 2022:6502). The reliability for each variable is presented in the following table.

Table 5. Reliability Test Results

No.	Cronbach's Alpha	Interpretation
1.	0.839	Very high

Before conducting hypothesis testing, the steps that must be taken are to conduct a normality test, a homogeneity test, an n-gain test, and a hypothesis test. The following presents the data from the results of the normality test, the homogeneity test, the n-gain test, and the hypothesis test in this study.

Table 6. Results of the Normality Test of Concept Understanding Ability Pretest of Experimental Class and Control Class

Tests of Normality

	Class	Kolmogorov-Smirnova			Shapiro Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Conceptual Understanding Ability	Experimental Class Pretest	.124	22	.200*	.975	22	.815
	Control Class Pretest	.123	22	.200*	.947	22	.279

From the table above, it is known that the normality test presented shows that the significant value produced in the experimental class is 0.815 ± 0.05, while the significant value produced in the control class is 0.279 ± 0.05, so it can be concluded that the residual value is normally distributed ≥.

After the data is tested for normality and produces normally distributed data, the next step is to find out whether the data has homogeneous variance or not. Homogeneity test analysis is a test of whether the variations of two or more distributions are the same (UR Anggraini, 2021:3272). The results of the homogeneity test are as follows.

Table 7. Results of the Homogeneity Test of Concept Understanding Ability Pretest of Experimental Class and Control Class

Test of Homogeneity of Variances					
		Levene Statistics	df1	df2	Sig.
Conceptual Understanding Ability	Based on Mean	1.305	1	42	.260
	Based on Median	1,332	1	42	.255
	Based on Median and with adjusted df	1,332	1	39,379	.255

	Based on trimmed mean	1,318	1	42	.257

Based on the results of the Test of Homogeneity of Variances table above, it is known that the significant values produced are four, namely based on mean 0.260 0.05. The sig value based on median 0.255 0.05. The sig value based on median and with adjusted df 0.255 0.05. Finally, the sig value from based on trimmed mean 0.2570.05. So it can be concluded that the data produced is homogeneous.≥ ≥ ≥ ≥

Next, the N-gain test is carried out, where this test is a test used to see the difference in post-test and pre-test values of the study. The following is a table of the results of the N-gain calculation in the experimental class I and control.

Table 8. N-Gain Test Data on Pretest and Posttest Score Improvement Experimental and Control Classes

Class	Average Pretest Score	Posttest Average	N-Gain Class	Category
Experiment	27.95	55.18	0.84	Tall
Control	30.81	50.59	0.67	Currently

The results of the analysis show that the experimental class has N-gain = 0.84 which means N-gain = 0.84 > 0.70 so that the score increase is categorized as high. While in the control class the results of N-gain = 0.67 which means N-gain = 0.67 < 0.30 so that the score increase is categorized as moderate. So from these results it can be concluded that the use of napier rod media in the experimental class is more effective than the control class.

Next is to conduct a hypothesis test using the t-test (independent t-test). This hypothesis test is used to determine the effect of using Napier Rod media on students' understanding of mathematical concepts. Where the decision making in the t-test is if the sig value> alpha (0.05) then H0 is accepted and Ha is rejected. This means that there is no effect of using variable x on variable y. So it can be said that the variable x (Solution) used in the study has an effect on variable y (problem). Likewise, if the sig value alpha (0.05) then Ha is accepted and H0 is rejected≤

Table 9. Results of Hypothesis Testing of Concept Understanding Ability Post- Test of Experimental Class and Control Class

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Conceptual Understanding Ability	Equal variances assumed	9,462	.004	10,706	42	.000	11,909	1.112	9,664	14.154
	Equal variances not assumed			10,706163		.000	11,909	1.112	9,641	14.177

Based on the table above, it is known that the significant value is .000 which is 0.000 0.05. It can be concluded that Ha is accepted and H0 is rejected, this states that there is an influence of napier rod media on the conceptual understanding ability of grade III students of SD 020252 Binjai ≤.

3.2. Discussion

Based on the results of the hypothesis above, it was found that the use of Napier's Rod Media in mathematics learning showed positive results. First, the average value of the ability to perform multiplication operations in students who used Napier's Rod Media was much higher than that of students in classes that did not use the media. This proves that Napier's Rod Media is a potential learning tool to improve understanding of mathematical concepts, especially multiplication operations. Where Multiplication is an important study in Basic Mathematics subjects that must be mastered by students. Mastery of the material on multiplication operations is important, so that students can master other basic competencies in Mathematics lessons (Melyani, 2022:285). Second, learning in the experimental class becomes more meaningful because students are given the opportunity to discover and understand multiplication operations through the visualization of number patterns displayed on Napier rods. Thus, this media is able to integrate concrete and abstract learning to improve student learning outcomes.

The use of Napier rod media certainly makes it easier for students in mathematics lessons, especially multiplication material. Where this is in accordance with the opinion Yasinta (2021:114) which states that the advantages of the multiplication bar technique include: 1) the multiplication arithmetic operation is simpler; 2) the method of working does not have many binding rules; 3) can increase students' interest in working on arithmetic operations because it does not drain students' brain memory; 4) learning Mathematics will be more enjoyable. In addition Aristiani (2013:296) also explained that on the Napier rod the image can be moved easily so that students can be more enthusiastic to be physically active by moving the number objects, the teaching pattern can make it easier for students to multiply because it is arranged in a square box, making it easier for children to multiply one number by another. These advantages make the Napier rod media a relevant learning medium, especially in helping grade III students understand the concept of multiplication better.

The application of concrete media in this learning is in line with several theories, one of which is the theory of constructivism learning where when students learn with the help of concrete media, it can increase students' interest in the lesson because students do not only listen or see the teacher explaining the material and writing it on the board, but they can explore the material from the media presented. The existence of this concrete media also provides students with experience in exploring knowledge related to the material they will learn so that learning will be more meaningful because in this case they are involved to actively participate in learning (Adhiyah, 2023:2077). In addition, Pavlov's behaviorism learning theory also explains that the use of learning media or concrete media is very suitable to be applied at the elementary or middle school level because it will implement a habituation and conditioning system. This system is effective in disciplining students and making the learning process more enjoyable, because teachers are always active, creative, and provide new innovations in teaching (Sulastri & Sudianto, 2024:33).

There are several other studies that are in line with this research, namely:Alwi's research, (2021:119)who obtained learning outcomes using Napier rods were able to influence students' understanding of the concept of multiplication and ultimately could influence students' mathematics learning, especially multiplication material. In addition Sudarto (2024:509) also conducted the same research in Class III SDN 21 Panyula. Where the results obtained were the ability to understand the concept of multiplication of Class III SDN 21 Panyula students before the use of Napier rod teaching aids was in the moderate category. Meanwhile, the ability to understand the concept of multiplication of Class III SDN 21 Panyula students after the use of Napier rod teaching aids was in the very good category (better than before the use of Napier rod teaching aids). Thus, the use of Napier

rod teaching aids has an effect on the ability to understand the concept of multiplication of Class III SDN 21 Panyula students.

4. CONCLUSION

This study can prove that the use of Napier rod media has an effect on the conceptual understanding ability of students in grade III of SD Negeri 020252 Binjai. Napier rod media significantly improves the conceptual understanding ability of grade III students in SD Negeri 020252 Binjai. This is proven through a hypothesis test with a significant value (p-value) of 0.000 (<0.05), so that the alternative hypothesis (Ha) is accepted. And the average N-Gain score for the experimental class is 0.70 (high category), better than the control class with an average score of0.84 > 0.70 so that the score increase is categorized as high. While in the control class the N-gain result = 0.67 which means N-gain = 0.67 < 0.30 so that the score increase is categorized as moderate. So from these results it can be concluded that the use of napier rod media in the experimental class is more effective compared to the control class

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