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Mathematical Problem Solving Ability Judging from the Percentile Intelligence of Class IV Students in the Problem Based Learning Model with Ethnomathematics Nuances

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ABSTRACT

The problem encountered in class IV at SD 2 Medini was that mathematics learning was still teacher-centred, yet to be linked to the experiences of the students themselves. Knowledge still needs to use media examples from the surrounding environment that are real and based on local culture. This research aims to determine students' problem-solving abilities in mathematics content through learning outcomes and students' intelligence percentages in ethnomathematics nuanced learning. The study was carried out using a mixed method with a sequential explanatory design (sequence of evidence). The sequential explanatory model is a combined research method that combines quantitative and qualitative research methods sequentially, where the first stage of research is carried out using quantitative methods and the second stage is carried out using qualitative methods. The results of the study on the application of the Problem-Based Learning model with nuances of ethnomathematics are effective on mathematical problem-solving abilities. This shows that the Problem-Based Learning model is able to improve student learning outcomes through the results of the T-test carried out in the experimental class and control class where the practical class applies nuanced learning ethnomathematics was able to increase learning outcomes by up to 34% and was supported by an N-gain test score of 0.75 with high criteria and a very effective effectiveness rating, while the control class was only at 0.57 with medium criteria and a less effective effectiveness level.

Keywords: *Problem Solving Ability, Intelligence Percentile, and Problem Based Learning, ethnomathematics.*

INTRODUCTION

Education is an important thing that is a necessity for every individual. Through education, individuals gain experience, potential and skills. According to Kunandar (2007:11), through education, a person will be equipped with knowledge, skills, expertise and, no less importantly, various types of life arrangements in the form of norms, positive rules and so on.

Education in Indonesia is currently experiencing a curriculum transformation. The curriculum implemented in Indonesia is the independent curriculum. This curriculum provides freedom for students to explore their talents and interests. One of the lessons in the independent curriculum is mathematics. Mathematics comes from the Latin word mathematics, which was originally taken from the Greek word mathematics, which means to study. The word originates from the word mathema, which is taken from knowledge or science. The word mathematics is also related to other words that are almost the same,

namely machine or therein, which means (thinking). So, based on the origin of the word, the word mathematics means knowledge obtained by thinking (Daut, 2016:59). Russeffendi (1988:148) in Daut (2016: 59) mathematics emphasizes reasoning activities, does not emphasize experimental results or observation results. Mathematics is formed because of human thoughts, which are related to ideas, processes and reasoning.

Mathematics is closely related to science and technology. Mathematics is a supporting science for other branches of science and mathematics itself. In this era of development, mathematics is needed in making decisions about problems. It cannot be denied that students must have mathematical abilities from the very beginning. According to Hendriana (Darwanto, 2019:21), mathematical abilities are as follows: 1) mathematical understanding abilities; 2) mathematical reasoning ability; 3) mathematical problem-solving abilities; 4) mathematical communication skills; 5) mathematical connection ability; 6) ability to think logically mathematically; 7) mathematical critical thinking skills; and 8) creative mathematical thinking abilities.

One of the abilities that students need to develop is mathematical problem-solving abilities. Sumardiyono Supinah (2010) in (Indarwati, 2014:20) problem-solving is a process of applying previously acquired knowledge to new, unknown situations. According to Polya (1985) in (Roebiyanto & Harmini 2017:21), problem-solving is an attempt to find a way out of a difficulty to achieve a goal that cannot be reached immediately. Roebiyanto & Harmini (2017:21) business problem solving looking for solutions or ideas regarding the plans to be completed. In this case, problem-solving can be interpreted as a process to resolve an issue so that the problem does not arise again.

Problem-solving abilities in Indonesia currently need to improve. Mathematics abilities in international classes in Indonesia still need to improve. This is proven by the results of the 2015 Trends In Mathematics and Science Study (TIMSS) in Syamsul and Novaliyosi (2019:563), showing that Indonesian students' achievement in mathematics was ranked 44th out of 49 countries with a score of 397, lower than the international average score of 500. Trends in International Mathematics and Science Study (TIMSS) is a global assessment of mathematics and science knowledge in 4th and 8th-grade students around the world. Apart from that, in 2019, Indonesia was absent from the implementation of TIMSS. Additionally, based on the 2022 PISA results released by the Ministry of Education and Culture, Indonesia is still experiencing a decline in learning outcomes from 2018 due to the pandemic. This means that there is a need to increase numeracy literacy, especially at the elementary school level.

Based on the results of learning observations in class IV at SD 2 Medini, mathematics learning is still teacher-centered and yet to be linked to the experiences of the students themselves. Knowledge does not yet use media examples from the surrounding environment that are real and based on local culture. So, in understanding mathematical concepts, especially material about flat shapes, students still need help. The mathematics learning outcomes of the majority of class IV students are still in the sufficient category.

In one class, there are different student abilities, and this will influence acceptance in understanding the material and solving problems. Some experts say that if children have a high intelligence percentage, they will easily accept the material. However, the facts in the field are sometimes different.

Children who have a high intelligence percentage do not necessarily have good achievements and abilities in understanding the material.

Intellectual intelligence is often called Presentil Intelligence. Increased mathematical problem-solving abilities can be seen through students' intelligence percentages. According to Beni (2012), Intelligence is human mental, thought or intellectual ability. Intelligence is part of higher-order cognition. Meanwhile, according to Purwa (2014: 141), intelligence or intelligence is a mental ability that a person has to respond to and solve problems based on quantitative matters and phenomena, such as mathematics, physics and historical data.

According to Sumardyono (in Ubayanti et al. 2016: 13), mathematical objects are socio-cultural-historical. Mathematics is part of his culture. Mathematics was born from a long, historical journey in human life. However, cultural aspects still need to be part of mathematics learning activities in elementary schools, so elementary school students are far from their culture.

According to Normina (2017), Education and culture are two related things because education changes according to cultural developments. Where education is a process of transferring cultural values, education and culture are interrelated. That is, education can make humans or people cultured, and culture can also guide people to live in accordance with the rules or norms that serve as guidelines for living life. Culture can be interpreted as the entire system of ideas, actions and results of human work to fulfil their lives by learning, which is structured in the life of society (Pasaribu, Rowland, 2015).

Learning mathematics related to culture is called ethnomathematics. Ethnomathematics was pioneered in 1985 by Ubiratan D'Ambrosio. Ethnomathematics is defined as mathematics applied by certain cultural groups, professional classes and vice versa (Gerdes in Tandailing, 2013). Through learning ethnomathematics and relating it to students' daily lives and experiences, it is hoped that students will be able to understand the concepts and problems presented in mathematics.

Learning that is not student-centred and does not use a suitable model makes learning less effective. In this case, the model that is suitable for developing mathematical problem-solving abilities is the Problem-based Learning (PBL) model. The PBL model is a learning model in which students work on real issues with the aim of compiling their knowledge, developing inquiry and high-level thinking skills, and developing independence and self-confidence (Suprihatiningrum, 2016) (Reski 2019:53).

The Problem-Based Learning learning model is a learning model where students are involved in learning activities and prioritize real problems in the home, school and community environment as a basis for gaining knowledge and concepts through skills in critical thinking and solving problems (Arrahim 2021:55).

LITERATURE REVIEW

Research that is relevant to the research to be conducted is "Improvement of Mathematical Problem-Solving Ability of High School Students through Problem Based Learning". This research was conducted by Elmiwati et al. (2020). The instruments in this article are the MPSA test using the t-test, two-way ANOVA test and one-way ANOVA test. Research design pretest-posttest control group design. The results of this research are as follows: 1) The increase in mathematical problem-solving abilities of students who receive PBL learning is better than students who receive conventional learning. 2) there is a significant interaction between PBL and

conventional models with mathematical problem-solving abilities, and 3) there is a significant difference in the increase in mathematical problem-solving abilities of students who receive PBL learning. The similarity with the research that will be carried out is that it aims to improve mathematical problem-solving abilities using the PBL model.

"The Influence of the PBL Model on the Communication and Mathematics Problem Solving Abilities of Fifth Grade Elementary School Students". This research was conducted by Kodariyati & Astuti (2016). The study conducted by Kodariyati was of the Quantitative type with a Pretest-Posttest Control Group Design. The instrument used to collect data is an objective description test. The research results show that (1) the PBL model has a positive and significant effect on mathematical communication skills with a significance value of less than 0.025; (2) the PBL model has a positive and significant effect on mathematical problem-solving abilities with a significance value of less than 0.025; (3) the PBL model has a positive and significant effect on communication skills and mathematical problem solving together with a significance value of less than 0.05. The similarity between the research that has been carried out and the one that will be carried out is that it aims to determine the effectiveness of Problem-Based Learning on mathematical problem-solving abilities. The selected instrument will use an objective description test.

Apart from that, another relevant research is "The Effect of Problem Based Learning (PBL) Instruction on Students' Motivation and Problem-Solving Skills of Physics". This research was conducted by Shishigu et al. (2016), where researchers used the Problem-Based Learning model to improve problem-solving skills in physics learning. The similarity in the research that will be carried out is using the PBL model to enhance problem-solving abilities, but the difference is in the teaching. The research that will be carried out focuses on mathematics learning. Quasi-experimental research method. The results of Shishigu et al.'s research show that there are significant differences between the control and experimental groups. Different researchers, as well as this research, prove PBL to be a more effective teaching method for selected physics topics compared to conventional teaching methods. Therefore, PBL is a good alternative teaching method to improve student academic achievement.

Apart from that, research that is relevant to the research that will be carried out is "Development of Mathematics Learning with an Ethnomathematics Approach Based on Local Kudus Culture". This research was conducted by Masamah (2018). This type of research is Research and Development. The data collection methods used in this research are interviews, validation, observation and questionnaires. As a result of this research, information was obtained that a form of ethnomathematics was found in local Kudus culture, which was focused on the location of the mosque and tower of Sunan Kudus, which in this case was only taken on the rectangular and triangular sides of the material. The validity of student worksheets is 3.97 in the valid category. The learning tools meet practical criteria with an average rating of B, which means they can be used with revision. Meanwhile, students' positive response to learning tools was 81%. What is common in the research that will be carried out is that the researcher will use several cultural buildings, such as the Kudus Tower and the Joglo Pencu traditional house, as aspects of ethnomathematics in teaching flat figure material.

There is also research from Ulfah (2018) with the title "Students' Ability to Solve Mathematical Problems on the Subject of Cubes and Blocks Based on Intelligence Quotient (IQ) Level in Class VIII MTS. PP Raudhatul Hasanah Medan".". The steps

used in this research are similar to the research that will be carried out, namely, using Polya problem-solving. The results of this research show that students with low IQs are only able to achieve 1-2 indicators of solving mathematical problems, while students with medium IQs are able to complete 3-4 hands of solving mathematical problems, and students with high IQs are able to achieve all indicators of solving mathematical problems.

MATERIALS & METHODS

The design used in this research is a mixed method with a sequential explanatory design (sequence of evidence). The sequential explanatory model is a combined research method that combines quantitative and qualitative research methods sequentially, where the first stage of research is carried out using quantitative methods, and the second stage is carried out using qualitative methods (Creswell, 2013).

Data collection for this research was carried out using two techniques, namely test techniques and non-test techniques. Test techniques are used in quantitative analysis to obtain data, which will later be used to test research hypotheses. In contrast, non-test techniques are used in qualitative research to determine problem-solving abilities in terms of students' intelligence percentages. The non-test process itself is carried out in several ways. Namely, observations carried out to determine the initial conditions of the experimental class and interviews regarding students' mathematical problem-solving abilities after being given treatment. The test carried out in this research was a test of mathematical problem-solving ability. The test instruments used have previously been tested on predetermined classes.

The data analysis used in this research is quantitative and qualitative. Quantitative data analysis, namely analysis of initial data on the trial test, includes question validity, differentiation, reliability and level of difficulty of the questions. Apart from that, there is also a normality test, homogeneity test, and initial data average similarity test. Final data analysis, namely a t-test completeness test using SPSS 25. Qualitative data analysis, namely a description of mathematical problem-solving abilities in terms of percentile intelligence.

RESULT

Analysis of Students' Problem-Solving Abilities

The Mathematical Problem-Solving Ability Test (TKPM) trial was held on September 27 2023, in class V of SD 3 Medini. The trial was carried out after the device was validated by three experts, namely two supervisors and a class IV teacher. The TKPM trial consists of 20 questions. This test question is intended to determine the validity of the items, their reliability, their level of difficulty, and their differentiating power. The results of the trial analysis of the Mathematical Problem-Solving Ability Test questions can be seen in Table 1.1 below

Table 1.1 Recapitulation of TKPM Trial Questions

Question Number	Validity		difficulty		Different Power		Reliability
	Score	Inf	Score	Inf	Score	Inf	
1	1,70	Invalid	0,55	medium	0,23	sufficient	0,898 (high)
2	1,41	Invalid	0,80	easy	0,06	poor	
3	4,35	Valid	0,85	easy	0,29	sufficient	
4	3,08	Valid	0,27	difficult	0,34	sufficient	
5	3,14	Valid	0,89	easy	0,17	poor	
6	3,82	Valid	0,56	medium	0,54	great	
7	6,47	Valid	0,75	easy	0,40	sufficient	
8	4,50	Valid	0,70	medium	0,37	sufficient	
9	3,84	Valid	0,83	easy	0,34	sufficient	
10	7,84	Valid	0,28	difficult	0,43	great	
11	5,45	Valid	0,87	easy	0,31	sufficient	
12	2,89	Valid	0,72	easy	0,34	sufficient	

13	1,65	Invalid	0,70	medium	0,23	sufficient	
14	2,92	Valid	0,67	medium	0,46	great	
15	1,65	Invalid	0,16	difficult	0,06	poor	
16	3,77	Valid	0,46	medium	0,26	sufficient	
17	5,85	Valid	0,82	easy	0,57	great	
18	6,09	Valid	0,29	difficult	0,46	great	
19	5,11	Valid	0,75	easy	0,60	great	
20	8,70	Valid	0,28	difficult	0,40	sufficient	

The results of the validation analysis of the 20 TKPM questions, as presented in Table 1.1, show that 16 of the 20 questions are said to be valid. This analysis uses a significance level of 5%.

The results of the Cronbach Alpha reliability analysis have a significance level of 5%, and the rtable is 0.388. In the calculations in Table 4.3, the rcount is 0.898 using the Cronbach Alpha formula. So, the pre-test questions are included in the high category. Apart from that, because count> rtable, the question is reliable. Of the 20 questions tested, there were nine questions in the easy category, namely numbers 2,3,5,7,9,11,12,17,19. The six questions in the medium category are 1,6,8,13,14,16. The five questions that were in the difficult category were 4, 10, 15, 18, and 20. Of the 20 questions that were tested, there were six questions with good differentiation, namely numbers (6, 10, 14, 17, 18, 19). 11 questions had good differential power. (1,3,5,7,8,9,11,12,13,16,20). Three questions with poor differential power (2,5,15).

Preliminary Data Analysis

1. Test the Normality Assumption

Test the assumption of normality using the Liliefors Test with SPSS 25. The initial data used by researchers is pretest score data. The hypothesis used is as follows.

H0: Student population score data is normally distributed

H1: Student population score data is not normally distributed

Table 1.2 Normality

Class	Std Deviation	Test Statistic	Sig- 2 taild	Sig
Experiment	9.06	0.159	0.136	0,05
Control	5.93	0.162	0.068	0,05

Based on the output above, it is known that the significance value (Sig.) for the experimental class is 0.136 while for the control class it is 0.068. Sig > 0.05, so it can be concluded that the residual value is normally distributed.

2. Test the Homogeneity Assumption

The homogeneity test is used to see whether the scores from the pretest and posttest come from similar variants or not. The following are the calculation results of the F-Test Two-Sample for Variances test with SPSS 25.

Table 1.3 Homogeneity

Class	g- trimmed mean	g
Experiment	0.119	05
Control	0.632	05

Based on the output above, it is known that the significance value (Sig.) Based on Mean in the experimental class is 0.119 while in the control class it is 0.632. The sig value is > 0.05, based on the results of the homogeneity test that has been carried out, it is then concluded that the two data from the pretest value are homogeneous.

3. Initial Data Average Similarity Test

The average similarity test was carried out on the pretest scores to measure students' initial abilities before being given learning in the experimental class and control class using SPSS 25.

Table 1.4 Average Similarity Test Results

Class	N	Mean	Std Deviation	Sig	Significant
Experiment	23	51.78	14.678	0.032	0.05
Control	27	49.81	8.936		

Based on the average test results, the initial results found that the average value of the experimental class was 51.78 and the control class was 49.81 with a difference of

1.97 in the sig value obtained at 0.032<0.05, so it can be interpreted that there is no difference in the students' initial abilities.

Final Data Analysis

The test result data obtained was analyzed to test the effectiveness of the ethnomathematics nuanced PBL learning model on mathematical problem-solving abilities. The data analysis used is as follows

1. T-test

When the data from the pretest and post-test scores are tested, the data is normally distributed, so the formula used in the t-test is a parametric formula. The t-test uses the Paired Sample t-Test formula with the help of spss 25 which is used in the t test. The results of the t-test analysis before and after using the ethnomathematics nuanced problem-based learning model.

Table 1.5 T test

Class	mean	Std Deviation	Sig- 2 taild	Sig
Experiment	34.0	5.461	0.000	0,05
Control	28.5	6.429	0.000	0,05

The test result data obtained was analyzed to test the effectiveness of the ethnomathematics nuanced PBL learning model on mathematical problem-solving abilities. The data analysis used is as follows: as The significance value (2-tailed) in the experimental class and control class is 0.000 < 0.05, indicating that there is a significant difference between the PreTest and PostTest. This shows that there is a significant influence, increased results, and differences in treatment given to each variable follows.

2. N Gain

The assessment between pretest and posttest scores is measured by analyzing the gain index. In this research, normalized gain (N gain) is used. Gain shows an increase in student learning outcomes in mathematics learning using a problem-based learning model with ethno mathematics nuances.

Tabel 1.6 Hasi N-Gain

Class	N	Std Deviation	Mean
Experiment	23	12.783	0,75
Control	28	11.843	0.57

Based on the results of the N-Gain score test, it shows that the average N-Gain score in the experimental class is 0.75 with a high category and a very effective level of effectiveness, while the control class is 0.57 with a medium category and a fairly effective level.

DISCUSSION

Problem-based learning with an ethnomathematics nuance is a form of learning that supports student activity while introducing the culture where students live. In the learning process, students are taught to recognize the social culture in the place where they live and, at the same time, understand the learning material provided through ornamental shapes and cultural objects associated with flat building material so that ethnomathematics is very suitable to be applied in fourth-grade elementary school mathematics learning.

The effectiveness of implementing the problem-based learning model with an ethnomathematics nuance is measured through the results of the pretest and posttest scores in the experimental class, which are compared with the control class where the course was not given treatment with the problem-based learning model with an ethnomathematics nuance. In the first step, a normality test and a homogeneity test were carried out to determine whether the data distribution was normal and homogeneous. The normality score for the experimental class was 0.136, while the control class was 0.068. Sig > 0.05, so it can be concluded that the residual value is normally distributed and then continued with the homogeneity test in the experimental class, which is 0.119, while in the control class, it is 0.632. Sig value > 0.05, based on the results of the homogeneity test that has been carried out, it is concluded that both data from the

pretest and posttest scores are homogeneous,

After carrying out the normality test and homogeneity test, the t-test was then carried out. From the results of the t-test, the significance value (2-tailed) in the experimental class and control class was 0.000 < 0.05, indicating that there was a significant difference between the PreTest and PostTest. This shows that there is a significant effect, an increase in results and differences in treatment given to each variable, with an average increase in the value of the experimental class 34 and the control class 28.

Then, an n-gain test is carried out to determine the effectiveness criteria of the learning model that has been implemented. The results of the N-Gain score test show that the average N-Gain score in the experimental class is 0.75, with a high category and very effective level of effectiveness, while the control class is 0.57 with a medium type and quite effective group, with an increased in the pretest score. And the experimental class post-test was 34%.

Then, the student learning results were compared with the results of the intellectual percentile test conducted through the Muria Kudus University psychology team institute. The intellectual percentile test showed that eight children had a superior level, five children were above average, 5 children were moderate, and two children were below average. The intellectual percentage score is in line with students' cognitive intelligence, where students in the superior category have high intermediate learning outcomes and students in the below-average sort have low learning outcomes.

CONCLUSION

Based on the results of research on mathematical problem-solving abilities in the Problem-Based Learning model with an ethnomathematics nuance at SD Negeri 2 Medini, several conclusions can be drawn as follows: The application of the Problem-Based Learning model with an ethnomathematics nuance is effective on mathematical problem-solving abilities. This is shown by the Problem-Based Learning model, which is able to improve student learning outcomes through the results of the T-test carried out in the experimental class and control class. In contrast, the practical course, which applies ethnomathematics nuanced learning, is able to increase learning outcomes by up to 34% and is supported by an N-gain test score of 0.75 with high criteria and a very effective interpretation, while the control class is only at 0.57 with medium criteria. The level of effectiveness could be more effective.

Students' intelligence percentages influence students' mathematical problem-solving abilities. Students with a high (superior) Percentile Intelligence score are able to obtain high cognitive learning outcomes, while students with an intelligence percentile that is below average also get low learning outcomes. Percentile intelligence was discovered after carrying out the CPM test with the Raven scale by the Psychology Team Institute. Muria Kudus University.

Declaration by Authors

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