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Rosiah Juliati Pulukadang[1]

REALISTIC MATHEMATICS LEARNING TO TEACH NEGATIVE NUMBER COUNTING OPERATIONS

Abstrak

Tujuan dari penelitian ini adalah untuk mengetahui dampak penerapan pembelajaran matematika aktual terhadap prestasi akademik siswa pada domain bilangan bulat. Penelitian ini menggunakan Desain Kelompok Kontrol Posttest-Only untuk tujuan melakukan penelitian. Peserta penelitian ini terdiri dari dua kelompok: kelas VII A yang berfungsi sebagai kelompok eksperimen yang berjumlah 22 siswa, dan kelas VII B yang berfungsi sebagai kelompok kontrol yang juga terdiri dari 22 siswa. Kelompok ini dipilih dari SMP Negeri 6 Langowan pada tahun ajaran 2022. Data yang dikumpulkan berasal dari hasil posttest pada kelompok eksperimen dan kontrol. Kelompok eksperimen menunjukkan rata-rata hasil belajar sebesar 77,3, sedangkan kelompok kontrol menunjukkan rata-rata hasil belajar sebesar 51,4. Uji normalitas data terpenuhi jika data mengikuti distribusi normal. Analisis data memberikan hasil dengan tingkat signifikansi 0,05, dimana nilai t_{hitung} sebesar 7,1039 lebih besar dari nilai t_{tabel} sebesar 1,6819. Temuan penelitian ini menunjukkan bahwa siswa yang menggunakan pendekatan matematika realistik pada materi bilangan bulat menunjukkan hasil belajar yang lebih unggul dibandingkan dengan siswa yang menggunakan metode pembelajaran standar.

Kata Kunci: Pembelajaran Matematika Realistik, Pembelajaran Konvensional, Hasil Belajar, Bilangan Bulat.

Abstract

The objective of this study is to investigate the impact of incorporating actual mathematics learning on student academic achievement in the domain of whole numbers. The present study employs a Posttest-Only Control Group Design for the purpose of conducting research. The participants of this study consist of two groups: class VII A, which serves as the experimental group and comprises 22 students, and class VII B, which serves as the control group and consists of 22 students. These groups were selected from SMP Negeri 6 Langowan during the 2022 academic year. The data collected were derived from the posttest outcomes in both the experimental and control groups. The experimental group exhibited an average learning outcome of 77.3, whereas the control group demonstrated an average learning outcome of 51.4. The normality test for the data is satisfied when the data follows a normal distribution. The data analysis yielded results with a significance level of 0.05, where the calculated t-value (t_{count}) was 7.1039, which is greater than the critical t-value (t_{table}) of 1.6819. The findings of this study indicate that students who employ a realistic mathematical approach to integer material exhibit superior learning outcomes compared to those who utilize standard learning methods.

Keywords: Realistic Mathematics Learning, Conventional Learning, Learning Outcomes, Integers.

[1]Mathematics Education Department, FMIPAK, Universitas Negeri Manado, Manado, Indonesia
rosiahpulukadang@unima.ac.id

INTRODUCTION

Education is important in producing highly qualified and dedicated human resources in today's post-modern era. In education, students are expected to be able to apply the lessons they learn in everyday life (Khasanah, 2015; Mansur, 2018; Sarwoedi, 2018; Asmara, 2019). Mathematics has a very large role in life. Of course, by learning mathematics, students are expected to be able to have abilities that are reflected through systematic, critical, honest, and disciplined thinking (Alimuddin, 2015; Igirisa, 2017; Ismail & Mudjiran, 2019; Irawati et al., 2022).

Seeing the important role of learning mathematics in everyday life, the process of learning mathematics carried out in schools must be of particular concern to teachers. In the process of education, teachers play a crucial role in guiding and facilitating students to develop a comprehensive understanding of their capabilities. Additionally, teachers are responsible for providing motivation to students, thereby encouraging them to exert maximum effort in their academic pursuits and attain success commensurate with their individual abilities (Nurhalimah et al., 2015; Silalahi, 2017; Hamdani & Wardani, 2019; Mubarok et al., 2020). So that currently, teachers who are facilitators of learning mathematics in schools must be able to carry out creative and innovative learning and be able to motivate students to learn more actively, critically, and systematically to discover mathematical knowledge independently (Afandi, 2014; Surat, 2016; Novtiar & Aripin, 2017; Anggreini & Priyojadmiko, 2022).

Based on the results of interviews with mathematics teachers at SMP Negeri 6 Langowan, the researcher concluded that the causes of the problems that occur in general are students' basic knowledge of mathematics and students' low understanding of the basic concepts of the lesson, thus making student activities less participating in the learning process and difficult to complete. Practice questions given by the teacher, thus making students' math scores in learning mathematics, especially in integer subjects, still below the KBM (Minimum Learning Criteria) even though this integer material is basic knowledge of mathematics, which is very important to be mastered by students in learning mathematics because related to almost all mathematical material.

This is because, in learning, students are directly treated to various forms of symbols, formulas, theorems, propositions, provisions, and abstract mathematical concepts. As a result, students need help understanding mathematical concepts (Novitasari, 2016; Jehenam et al., 2019; Diana et al., 2020). This causes the learning objectives to fail to be achieved. In learning like this, students' thinking is also not appreciated (Anhar, 2013; Maslukiyah & Rumondor, 2020; Pratiwi, 2023). In addition, learning that only imparts knowledge to students will also impact students' activeness in the learning process. Students only memorize various forms of symbols, formulas, theorems, propositions, provisions, and abstract mathematical concepts that are taught so that they cannot remember them in time. Old and lack of understanding of mathematical concepts (Hidayati, 2014; Suparni, 2015; Fahrudin, 2018).

Therefore, it takes a step to create learning that hones students' abilities to solve problems in everyday life or the world that is close to students. The step that is considered to help with these learning problems is through a realistic mathematics learning approach (Saefudin, 2012; Heryan, 2018; Baharuddin, 2020). This realistic mathematics learning emphasizes real contexts known to students and the process of constructing mathematical knowledge by students with contextual problems (Ningsih, 2014; Astuti, 2018; Chisara et al., 2019). By learning realistic mathematics, learning starts from the world close to students so that students will understand various forms of symbols, formulas, theorems, propositions, provisions, and abstract mathematical concepts more easily (Pasaribu, 2017; Sinaga, 2019). In constructing knowledge, students can interact with other students (Rahmawati, 2013; Sundawan, 2016; Prijanto & De Kock, 2021). By constructing it themselves, students can actively learn (Kulsum & Nugroho, 2014; Insyasiska et al., 2017; Diva & Purwaningrum, 2022). So that students do not only memorize the material but understand the concept so students will easily understand and remember it (Hanifulany, 2013; Kurnianingtyas, 2019; Firdaus, 2023).

The pedagogical approach known as PMR places significant emphasis on the process through which students engage in the reimagining and reconstruction of mathematical concepts and methods within the framework of contextual situations. The PMR approach in mathematics education involves utilizing real-life situations and the surrounding environment to enhance the learning process and achieve the desired objectives of mathematics education (Holisin, 2016; Febriyanti & Irawan, 2017; Sartika, 2019). The concept of reality pertains to tangible or perceptible entities that students can observe or comprehend through mental visualization. On the other hand, the term environment refers to the surroundings in which students find themselves, encompassing the school, family, or community settings that students can grasp (Ningsih, 2014; Kaunang, 2018; Handayani & Irawan, 2020). The environment in question is commonly referred to as the everyday environment.

Based on the description, PMR is an educational methodology that diverges from traditional instructional methods by centering on problem-solving activities that are grounded in students' personal experiences. In this scenario, individuals who are actively engaged in the educational process, namely students and teachers, assume the role of facilitators. In the context of mathematics as a human endeavor, it is imperative to provide students with many opportunities to autonomously explore and rediscover mathematical ideas and concepts through their interactions with the real world. Upon the acquisition of mathematical concepts, students can apply them to solve associated problems, hence enhancing their cognitive capacity in relation to these mathematical concepts.

METHOD

This study is considered experimental as it involves the administration of a treatment to research participants, followed by an examination of the resulting effects of this treatment. The experimental classes received treatment in the form of PMR learning, while the control classes underwent traditional learning. The study examines the independent factors of the PMR technique and conventional learning. The class instructed using the PMR methodology can be classified as an experimental group, whilst the class instructed using standard teaching methods can be considered as the control group. The focal variable in this study pertains to the learning outcomes of students in relation to their proficiency in solving equations involving negative numbers. The outcome of this investigation pertains to the disparity observed in the scores obtained from the posttest and pretest assessments.

The utilized experimental design is the Nonequivalent Control Group Design. The experimental design can be formulated as follows:

Table 1. Research Design

Class	Pretest	Treatment	Post-test
Experiment	Y_{1E}	X	Y_{2E}
Control	Y_{1K}		Y_{2K}

Information:

Y_{1E} : Initial test score for the experimental class
Y_{1K} : Initial test score for control class
X : Learning, namely the application of realistic mathematics learning from negative number counting equations.
Y_{2E} : Experimental class final test score
Y_{2K} : Final test score for control class

The study population comprised all pupils enrolled at SMP Negeri 6 Langowan, encompassing three distinct classes. In this study, the sample consisted of two randomly selected classes out of the three existing courses. The data in this study was obtained using the learning outcomes test instrument, which has undergone prior validation and reliability testing. The quantitative data received from the learning outcomes test is subjected to analysis to characterize and interpret the findings. The processing of quantitative data is conducted through two primary stages. The initial phase involves conducting statistical tests to establish the necessary conditions for hypothesis testing. Specifically, this includes assessing the normality of the distribution of the sample subject data and examining the homogeneity of variance. The second stage involves doing statistical tests, specifically the t-test and one-way ANOVA, to see whether there are significant differences between the groups. This analysis will be performed using the SPSS-17 for Windows software.

RESULT AND DISCUSSION

In this study, prior to testing the hypothesis using the t-test, the normality test and homogeneity of variance test were first carried out. The data used is the difference in the initial test (pretest) and the posttest results from the two classes, namely the experimental class and the control class. Analysis of the results of the initial test (pretest) and the posttest (posttest) was carried out to determine the normality and uniformity of the data as a condition for conducting experiments on the two classes taken based on randomization. Therefore, the normality test, variance homogeneity test, and hypothesis test are presented as follows.

1. Testing Requirements Analysis

Prior to conducting the t-test to assess the hypothesis in inferential analysis, it is customary to first administer the normality test and homogeneity of variance test. The utilized method involves comparing the disparity between the pretest and posttest outcomes of two distinct groups, specifically the experimental and control classes.

An examination was conducted to analyze the outcomes of the pretest and posttest, with the aim of assessing the normality and uniformity of the data. This assessment was necessary to establish the suitability of conducting experiments on the two randomly selected groups. Consequently, the normality test, variance homogeneity test, and hypothesis test are presented in the following manner:

a. Normality Test Using Minitab Software

1. Experimental Class

Data on the difference in pretest and posttest values from the experimental class for the normality test can be seen in the following figure:

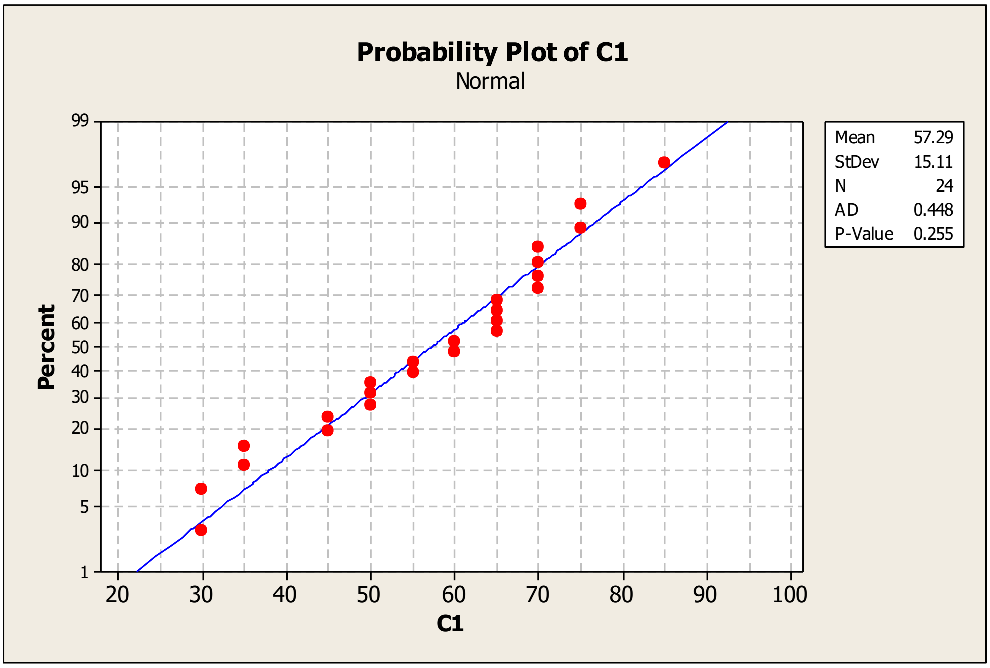

Figure 1. Normal probability distribution graph for experimental class

The p-value in Figure 1 is calculated to be 0.255, indicating that there is no strong evidence to reject the null hypothesis. Additionally, the data plots in the figure exhibit a tendency to converge towards a single straight line. The normal distribution of the beginning score (pretest) for the experimental class can be inferred from the fact that the p-value (0.255) is greater than the significance level α (0.05).

2. Control Class

Data on the difference between pretest and posttest scores from the experimental class for the normality test can be seen in the following picture:

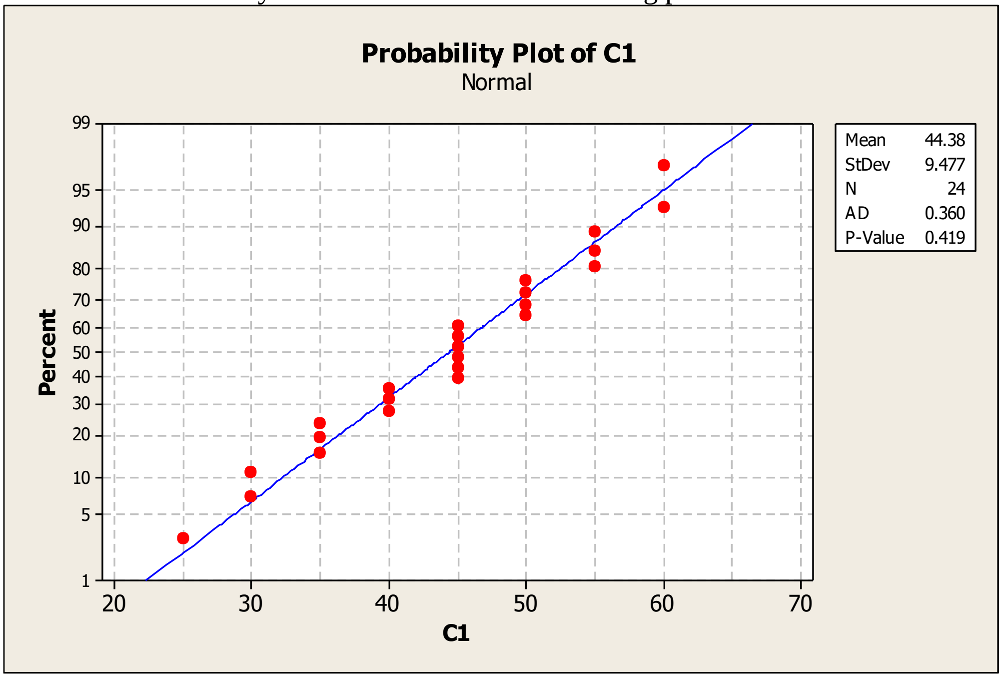

Figure 2. Graph of Control Class Normal Opportunity Distribution

The p-value, as depicted in Figure 2, is determined to be 0.419. Additionally, the data plots exhibit a tendency to converge in a linear fashion. The normal distribution of the final test scores (posttest) for the control class may be inferred as the p-value (0.419) is greater than the significance level (α) of 0.05.

3. Variance Homogeneity Test Using SPSS Software

Based on the homogeneity test with the f test statistic on the pretest results, with ${s_E}^2$ = 125.36 and ${s_K}^2$ = 79.30, f_{count} = 1.58. Because $f_{1-\frac{\alpha}{2}} = 0{,}43 < f_{count} = 1{,}581 < f_{\frac{\alpha}{2}} = 2{,}21$ then $H_0 : {\sigma_1}^2 = {\sigma_2}^2$, the variance of the two classes, namely the experimental and control classes, is homogeneous or the same.

b. Hypothesis test

H_0 : μE = μK
H_1 : μE > μK
With:
μE = average student learning outcomes taught using PMR,
μK = average student learning outcomes taught without using PMR.

Given that the normality and homogeneity criteria have been satisfied, it is appropriate to proceed with the t-test statistics. According to the criteria for hypothesis testing, the null hypothesis (H_0) should be rejected if the test statistic falls within the critical region. Based on the outcomes of the t-test conducted to examine the hypothesis, it was observed that the calculated t-value (t_{count}) was 3.549, while the critical t-value (t_{table}) at a significance level (α) of 0.05 was 1.645. The calculated test statistic, t_{count}, is 3.549, which exceeds the critical value, t_{table}, of 1.645. This indicates that the test statistic falls within the critical region. This indicates that there is sufficient evidence to support the acceptance of the alternative hypothesis (H_1). Consequently, it may be inferred that the null hypothesis (H_0) should be rejected in favor of the alternative hypothesis (H_1), specifically indicating that the mean of the experimental group (μE) is greater than the mean of the control group (μK). This implies that the mean educational achievements of students instructed with the use of PMR exhibit greater levels compared to those students who are not exposed to PMR.

Based on the findings of the inferential analysis conducted, it was seen that the group of students who received instruction utilizing PMR exhibited discernible variations in their learning outcomes. The difference between the average posttest score and the pretest score is evident in both classes. In the experimental group, the mean difference between the posttest score and the pretest score was found to be 57.29, which was statistically more significant compared to the mean difference of 44.37 observed in the control group.

Upon doing a t-test analysis, it was determined that the observed difference between the two means yielded a t-value of 3.549, which above the critical t-value of 1.645. This finding demonstrates a notable disparity in the educational achievements between the two groups, with students instructed utilizing the PMR approach exhibiting superior learning outcomes compared to students who were not exposed to PMR. This aligns with the viewpoint put forth by Mangelep (2010), which posits that PMR (Problem-based Mathematical Reasoning) is an instructional approach in mathematics education that utilizes students' personal experiences and real-life events as a vehicle for comprehending mathematical problems. The goal of PMR is to foster a comprehensive understanding of mathematical concepts, whereby students gradually develop their problem-solving skills and enhance their mathematical and logical reasoning abilities.

2. Discussion

The findings from the study conducted in the experimental class at SMP N 6 Langowan, which employed a realistic mathematics approach in teaching integer subject, indicate the presence of overall disparities in learning outcomes. This is demonstrated by the mean student learning outcomes derived from the assessments administered to both groups, namely the average learning outcomes of the experimental class, which amounted to 77.27, surpassing the average learning outcomes of the control class, which amounted to 51.36. This demonstrates that the instruction of integer concepts through the Indonesian realistic mathematics approach surpasses that of conventional learning.

Based on the results of the descriptive analysis and the two-sample t-tests conducted at a significance level of 0.05, it can be concluded that the learning outcomes of the experimental class surpass those of the control class. Based on the evidence, it can be inferred that the attainment of student learning outcomes in the domain of integers is greater when employing a realistic mathematics approach compared to standard learning methods.

Based on the comprehensive presentation and subsequent analysis of the research findings, it can be inferred that the experimental study titled "Enhancing Negative Number Computation Skills through Realistic Mathematics Learning" has demonstrated the effectiveness of employing a realistic mathematical approach in improving the academic performance of middle school students in Grade VII at SMP Negeri 6 Langowan. The implementation of a pragmatic mathematical methodology can facilitate the comprehension of mathematical concepts for students, hence enhancing their motivation to engage in the study of mathematics. Ultimately, this endeavor encompasses the acquisition of knowledge by students, collaborative efforts, and the provision of avenues for the cultivation of their inherent abilities. Hence, it can be inferred that the utilization of a realistic mathematics approach in teaching integer concepts yields superior results compared to standard instructional methods.

CONCLUSION

Based on the contextual information, review of relevant literature, hypothesis formulation, as well as the presentation and analysis of research findings and subsequent discussion, it can be inferred that the utilization of a realistic mathematical approach to teach integer concepts yields superior learning outcomes in students, as compared to the conventional instructional methods.

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