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Improving students' understanding of plane geometry concepts through simple concrete media among fifth-grade students at sdn 3 balai karangan

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Abstract

This study aimed to determine the effect of simple concrete media on fifth-grade students' conceptual understanding of plane geometry. The study was motivated by students' low understanding of area and perimeter concepts, as they tended to memorize formulas without understanding their meanings. This research employed a quantitative approach with an experimental method and a one-group pre-test-post-test design. The sample consisted of 22 fifth-grade students from Class VB at SDN 3 Balai Karangan, selected using purposive sampling Data were collected through pre-test and post-test instruments and analyzed using descriptive statistics, the Shapiro-Wilk normality test, the Paired Samples t-Test, and N-Gain analysis. The results showed an increase in the mean score from 62.73 in the pre-test to 72.05 in the post-test, with a significance value of 0.000 ($p < 0.05$). However, the average N-Gain score was 0.2774, which falls into the low category. Thus, the use of simple concrete media had a positive and statistically significant effect on students' conceptual understanding of plane geometry.

Kata kunci
media konkret sederhana; pemahaman konsep; bangun datar; matematika; sekolah dasar.

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan media konkret sederhana terhadap pemahaman konsep bangun datar siswa kelas V SD. Rendahnya pemahaman konsep luas dan keliling menjadi latar belakang, di mana siswa cenderung menghafal rumus tanpa memahami makna. Penelitian menggunakan pendekatan kuantitatif dengan metode eksperimen dan desain one group pre-test post-test. Sampel terdiri dari 22 siswa kelas Vb SDN 3 Balai Karangan yang dipilih secara purposive sampling. Data dikumpulkan melalui tes (pre-test dan post-test) dan dianalisis menggunakan statistik deskriptif, uji normalitas Shapiro-Wilk, uji hipotesis Paired Samples t-Test, serta analisis N-Gain. Hasil penelitian menunjukkan peningkatan nilai rata-rata dari 62,73 (pre-test) menjadi 72,05 (post-test) dengan signifikansi 0,000 ($p < 0{,}05$). Namun, rata-rata N-Gain sebesar 0,2774 termasuk dalam kategori rendah. Dengan demikian, media konkret sederhana berpengaruh positif dan signifikan terhadap pemahaman konsep bangun datar, meskipun peningkatannya belum optimal dan belum merata pada seluruh siswa.

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INTRODUCTION

Mathematics is one of the subjects taught at every level of education. One of the fundamental topics in mathematics is plane geometry. Students' understanding of area and perimeter in plane geometry remains an important issue in elementary mathematics learning, particularly in fifth-grade students. According to Sudiana (in Suarjana et al., 2017, mathematical concepts should be introduced through experiences involving the manipulation of groups of real and natural objects. If mathematics is taught abstractly from the beginning, students may experience mathematics anxiety because they are not yet capable of abstract reasoning (Hasna et al., 2024). Therefore, mathematics learning requires instructional aids, namely real objects that can be modified in terms of form, quantity, and grouping (Dienes, 1960; Suparni, 2015). Jean Piaget (in Babullah, 2022) proposed a theory of cognitive development that divides children's development into four stages. Grade V elementary school students, aged approximately 10-11 years, are generally in the concrete operational stage. At this stage, children begin to think logically about concrete objects and events. According to Piaget (in Babullah, 2022), children in the concrete operational stage need concrete objects to understand abstract concepts. Therefore, students can develop a deeper understanding of concepts when they directly observe and manipulate concrete objects.

Bruner (as cited in Hasanah et al., 2014) proposed a learning theory that emphasizes three stages of learning: (1) the enactive stage, in which learning occurs through direct manipulation of objects; (2) the iconic stage, in which learning occurs through images or visual representations; and (3) the symbolic stage, in which learning occurs through abstract symbols. Bruner's theory is highly relevant to the use of simple concrete media in plane geometry learning because it enables students to learn gradually, moving from concrete experiences to abstract understanding. In essence, learning is a process of transmitting information from the communicator (teacher) to the communicant (student) as the receiver (Nasarudin, 2015). When the learning environment is designed systematically, learning objectives can be achieved optimally (Saleh et al., 2023).

In Bloom's taxonomy, conceptual understanding in mathematics is defined as the ability to construct meaning from instructional material, including including information that is spoken, written, or demonstrated by teachers and other sources.by teachers or others. Thus, conceptual understanding in mathematics refers to students' ability to understand, absorb, and internalize mathematical concepts deeply and comprehensively (Anderson & Krathwohl, 2001). Skemp (in Mytra & Heriyanti, 2020) classifies understanding into two types: instrumental understanding and relational understanding. Instrumental understanding refers to the ability to use formulas or procedures without understanding the reasons behind them, whereas relational understanding refers to the ability to use formulas or procedures while also understanding the reasons behind them.

The preliminary study conducted through classroom observations and interviews with the mathematics teacher of fifth-grade students at SDN 3 Balai Karangan revealed that many students had difficulty mastering and understanding the concepts of area and perimeter in plane geometry. Based on the pre-test administered to 22 students in Class VB, the mean score was 62.73, with scores ranging from 40 to 80. The standard deviation of 10.99 indicated that students' abilities were highly varied. Students tended to merely memorize formulas without truly understanding the meanings of area and perimeter, how to use units, or how to apply formulas to different types of plane figures. This is consistent with the findings of Zulkarnain and Budiman (2019), who stated that conceptual understanding has a significant positive effect on students' mathematical problem-solving ability. Therefore, low conceptual understanding may also lead to weak problem-solving ability. With a mean score of only 62.73, which was below the minimum mastery criterion, students' achievement in this material was relatively low, especially in terms of understanding and applying concepts in the given problems.

One strategy that can be used to address this problem is the use of instructional media, which can be made from materials available in the surrounding environment. According to Schramm (in

Neni Isnaeni & Dewi Hildayah, 2020), instructional media are tools used in the learning process, including teaching aids employed by teachers and communication tools that convey instructional messages from learning resources or teachers to learners.

The concept of concrete-object media can also be understood as teaching aids. Subari (in Pourisah & Rosidi, 2022) stated that teaching aids are tools used by teachers to present or demonstrate instructional material in order to provide a very clear understanding or illustration of the lesson being taught. Thus, simple concrete media are media that students can directly see, touch, and manipulate during learning activities.

Simple concrete media are also easy to obtain, affordable, and can be can be easily created using materials available in the surrounding environment (Fitri Ar Rahmah, 2025). The use of concrete instructional media in mathematics learning has been proven effective in improving students' understanding (Taher & Desyandri, 2022). Concrete media allow students to learn through direct experience or learning by doing, so the concepts being studied become easier to understand and remember (Khairunnisa & Ilmi, 2020). Simple concrete media have several advantages: they are accessible, inexpensive, and can be created by both teachers and students. According to Yuliana and Budianti (2015), concrete media provide clear and observable representations of concepts facilitate interaction with students through multiple senses, have high flexibility for use in other subjects, and can be manipulated according to learning needs, situations, and conditions.

This study aimed to improve students' understanding of plane geometry concepts through simple concrete media among Grade V students at SDN 3 Balai Karangan. The study is expected to contribute positively to improving the quality of mathematics learning, particularly in elementary school geometry instruction.

RESEARCH METHOD

This study employed a quantitative approach with an experimental research method. The design used was a one-group pre-test-post-test design (Sugiyono, 2019). The research design is presented in Table 1.

Table 1. Research Design

O1	X	O2

(Source: Sugiyono, 2019)

O1: Initial test (pre-test) used to determine students' prior ability in plane geometry before treatment using media.

X: Treatment in the form of plane geometry instruction using simple concrete media.

O2: Final test (post-test) administered to determine students' ability in plane geometry after treatment.

There were two variables in this study. The independent variable was the use of simple concrete media in mathematics learning on plane geometry. The dependent variable was the conceptual understanding of plane geometry among Class VB students at SDN 3 Balai Karangan.

The study was conducted at an elementary school in West Kalimantan, Indonesia, located in Dusun Balai Karangan IV, Balai Karangan Village, Sekayam District, Sanggau Regency, West Kalimantan Province. The intervention was conducted over four instructional sessions.The population consisted of all Grade V students at SDN 3 Balai Karangan in the 2025/2026 academic year, totaling 43 students from two parallel classes, Class VA and Class VB. The sample was selected using purposive sampling (Sugiyono, 2019), based on the consideration that Class VB had a lower mathematics mean score than Class VA according to previous daily test results and therefore required instructional intervention using concrete media. The selected sample consisted of 22 students in Class VB, comprising 8 male and 14 female students.

Data were collected through three techniques. First, a test consisting of 10 multiple-choice items and 5 essay questions was administrated for both the pre-test before treatment and the post-test after treatment. Second, observations were conducted to examine students' activities during the learning process using concrete media. Third, documentation was collected in the form of photographs of learning activities students' work, answer sheets, and score lists.

Data analysis techniques included descriptive statistics to summarize pre-test and post-test results, including the mean, highest score, and lowest score (Martias, 2021). The Shapiro-Wilk normality test was used to examine data distribution because the sample size was relatively small ($n = 22 < 30$) (Wara et al., 2025). Hypothesis testing was conducted using the Paired Samples t-Test to determine differences in learning outcomes before and after treatment (Rietveld & Van Hout, 2017). N-Gain analysis (Hake, 1999) was used to determine the increase in conceptual understanding, using the criteria $g > 0.70$ for high improvement, $0.30 <= g <= 0.70$ for moderate improvement, and $g < 0.30$ for low improvement. All data were analyzed using SPSS version 25.

RESULTS AND DISCUSSION

The findings indicate that concrete media can support instructional delivery, facilitate students' conceptual understanding, and help students understand the material in a concrete manner. Based on the analysis of pre-test data using SPSS version 25 in the first week of the study, the following results were obtained.

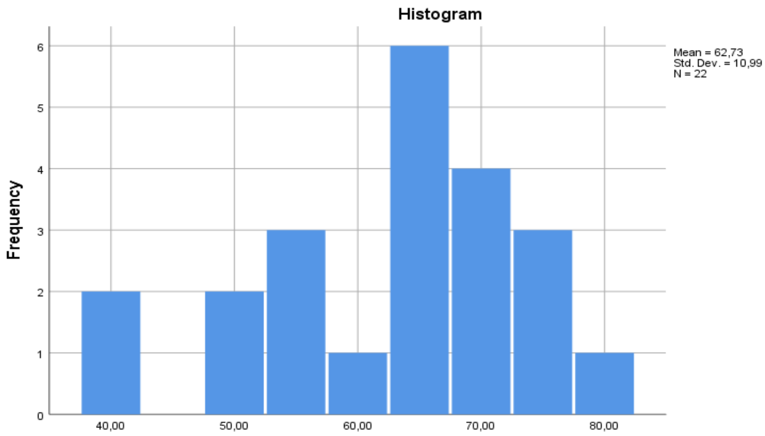

Figure 1. Histogram of the Pre-test Score Distribution for Conceptual Understanding of Plane Geometry

Figure 1 shows the distribution of pre-test scores for students' conceptual understanding of plane geometry in Class VB at SDN 3 Balai Karangan. The score range was from 40 to 80, with the highest frequency concentrated around a score of 65 and a mean score of 62.73. The standard deviation of 10.99 indicates considerable variation differences in students' abilities before instruction was delivered. This indicates that most students had only moderate understanding and required further instructional treatment.

The instructional activities began after administering the pre-test. The treatment was provided in the second and third weeks. During the treatment sessions, the researcher used concrete media to explain plane geometry concept. In the fourth week, a post-test was administered to identify changes in learning outcomes. The post-test data analysis is presented below.

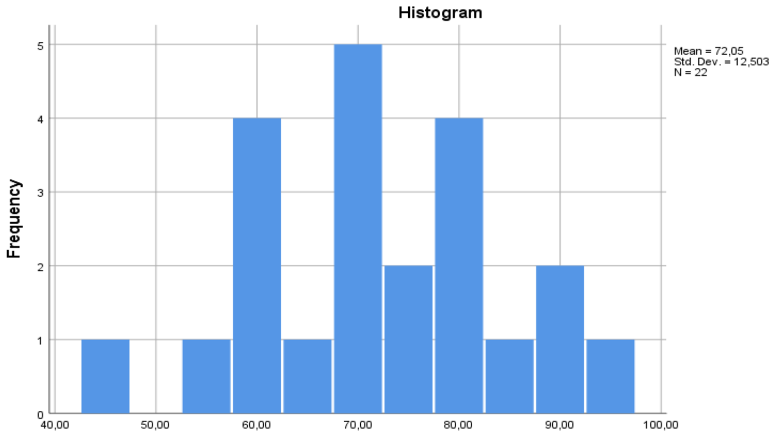

Figure 2. Histogram of the Post-test Score Distribution for Conceptual Understanding of Plane Geometry

Figure 2 shows that students' scores increased after the treatment. Most scores were in the 70-90 range, and the post-test mean increased to 72.05. This result indicates an improvement in students' understanding of plane geometry concepts. However, the standard deviation also increased to 12.50, indicating that variation in students' abilities remained high. In other words, although there was an overall improvement, suggesting that the effectiveness of the intervention varied across individual learners.

Based on the pre-test and post-test results, the distribution shifted from the middle score range of 60-70 to a higher score range of 70-90. This reinforces the evidence that students' understanding of the material generally improved.

Before proceeding to the next stage, a normality test was conducted to ensure that both pre-test and post-test data were normally distributed. The normality test was performed using the Shapiro-Wilk test in SPSS with a sample size of 22 students. The results are presented in Table 2.

Table 2. Normality Test Results for Pre-test and Post-test

	Shapiro-Wilk Statistic	Shapiro-Wilk Df	Shapiro-Wilk Sig.
Pre-test Conceptual Understanding of Plane Geometry	0.930	22	0.124
Post-test Conceptual Understanding of Plane Geometry	0.974	22	0.795

Table 2 shows that the Shapiro-Wilk normality test in SPSS version 25 produced a pre-test significance value of 0.124 and a post-test significance value of 0.795. The null hypothesis (H0) in the normality test states that the data are normally distributed. The decision criterion is that H0 is accepted if the significance value is greater than 0.05 (Ghasemi & Zahediasl, 2012). Since both significance values were greater than 0.05, H0 was accepted. Therefore, the pre-test and post-test data in this study were normally distributed.

Hypothesis testing was conducted using the Paired Samples t-Test to determine differences in students' learning outcomes before and after treatment. The results are shown in Table 3.

Table 3. Paired Samples t-Test Results

Pair	Mean	N	Std. Deviation	Std. Error Mean
Pre-test Conceptual Understanding of Plane Geometry	62.7273	22	10.98996	2.34307
Post-test Conceptual Understanding of Plane Geometry	72.0455	22	12.50325	2.66570

Table 3 shows that the mean pre-test score for students' conceptual understanding of plane geometry was 62.73, whereas the mean post-test score increased to 72.05. This indicates an increase of 9.32 points after treatment. The significance value (Sig.) was 0.000 < 0.05; therefore, H0 was rejected and H1 was accepted. This means that there was a significant difference between students' learning outcomes before and after instruction using concrete media.

N-Gain analysis was conducted to determine the improvement in students' conceptual understanding. The results are presented in Table 4.

Table 4. Descriptive Statistics of N-Gain Results

	N	Minimum	Maximum	Mean	Std. Deviation
N-Gain score	22	0.00	0.75	0.2774	0.20065
N-Gain percentage	22	0.00	75.00	27.7435	20.06539
Valid N (listwise)	22				

Table 4 shows that the average N-Gain score was 0.2774, or 27.74%, which falls into the low category. This indicates that although learning with concrete media improved students' learning outcomes, the improvement was not yet optimal. Some students experienced only slight improvement, and some even obtained N-Gain score close to 0.00. Nevertheless, several students reached a maximum N-Gain score of 0.75, which belongs to the high category, indicating that concrete media were highly effective for some students.

The results show that the use of concrete media in learning plays an important role in helping teachers present instructional content and helping students understand plane geometry concepts in a tangible way. Concrete media enable students to learn through direct experience, making abstract concepts easier to understand.

Based on the pre-test results, the initial ability of Class VB students at SDN 3 Balai Karangan in understanding plane geometry concepts was still in the moderate category, with a mean score of 62.73. The standard deviation of 10.99 indicated variation in students' abilities. This finding is consistent with Piaget's theory as cited in Babullah (2022)which states that elementary school students are in the concrete operational stage, meaning that their abstract thinking abilities remain limited and varied.

After treatment using concrete media, the post-test results showed an increase in the mean score to 72.05, along with a shift in score distribution from the 60-70 range to the 70-90 range. This finding supports Bruner's theory (in Hasanah et al., 2014), which states that learning through the enactive stage, or manipulation of concrete objects, helps students gradually understand abstract concepts.

Although improvement occurred, the post-test standard deviation increased to 12.50, indicating that differences in students' abilities remained high. This is in line with Yuliana and Budianti (2015), who stated that the effectiveness of concrete media is influenced by students' internal factors, such as motivation and learning engagement.

The hypothesis test showed a significance value of 0.000 < 0.05, meaning that there was a significant difference between learning outcomes before and after treatment. This finding demonstrates that concrete media have a positive effect on students' conceptual understanding of

plane geometry, as stated by Taher and Desyandri (2022), who argued that concrete media are effective in transforming abstract concepts into tangible learning experiences.
The N-Gain score of 0.2774, which falls into the low category, indicates that the improvement in students' understanding was not yet optimal or evenly distributed. This finding confirms Dienes' theory (in Suparni, 2015), which emphasizes that the success of concrete media depends strongly on the variation of forms, quantities, and grouping of objects used, as well as the time allocated for learning.

Overall, the use of concrete media was proven to have a positive and significant effect on students' conceptual understanding of plane geometry. This result is consistent with learning theories that emphasize the value of direct experience, or learning by doing, in developing elementary school students' understanding of mathematical ideas.

CONCLUSION

Based on the research findings and discussion, it can be concluded that the use of simple concrete media in plane geometry learning had a positive and significant effect on improving the conceptual understanding of Class VB students at SDN 3 Balai Karangan. This is evidenced by the increase in the mean score from 62.73 in the pre-test to 72.05 in the post-test, as well as the Paired Samples t-Test result showing a significance value of 0.000 (< 0.05). However, the N-Gain analysis produced an average score of 0.2774, which is categorized as low, indicating that the improvement in students' conceptual understanding was not yet optimal or evenly distributed. These findings confirm that simple concrete media are effective as instructional aids for bridging abstract mathematical concepts with students' real experiences in accordance with their concrete operational stage of development. Nevertheless, their success depends on students' internal factors, media variation, time allocation, and the teacher's ability to manage learning. Therefore, teachers are advised to optimize the use of concrete media by combining them with varied learning strategies and intensive guidance. Students are encouraged to participate more actively in learning activities, while schools need to support the provision of adequate facilities and infrastructure. Future researchers are encouraged to extend the research duration, increase the sample size, and combine concrete media with other instructional methods so that learning outcomes can improve more optimally and equitably.

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