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Improving Junior High School Students Mathematical Understanding Ability Through PowerPoint-Assisted Visual Media

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Abstract

Students typically have less interest in learning mathematics because it is still seen as a challenging subject. As a result, when compared to other disciplines, the pupils' mathematics understanding abilities remained below average. The aim of this study was to find out how employing visual aids, such as PowerPoint, to teach geometric shapes to students improved their mathematical comprehension skills. This kind of study uses a random subject posttest design and is therefore quasi-experimental. The population of this study consisted of students in class VIII SMPN 1 Pagelaran; the samples were drawn using the purposive sampling technique from students in class VIII C, which was the experimental class, and class VIII D, which was the control class. The t-test, homogeneity test, and normalcy test are the data analysis methods employed. With a significant rate of 0.05, the testing results for the hypothesis produced $t_{stat} = 3.2 > t_{table} = 1.6801$. This indicates that while Ha is acceptable, Ho is denied. This demonstrates how employing PowerPoint-assisted visual aids in mathematics instruction increases students' capacity for mathematical knowledge.

Keywords: Mathematical Understanding Ability, Visual Media, Powerpoint

1. Introduction

One science that is crucial to the field of education is mathematics. In addition to its reputation as the Queen of Science, mathematics is stated to be a field of study that links to real-world applications and helps other fields of knowledge (Chotimah, Bernard, and Wulandari, 2018). This demonstrates that math is a subject that needs to be studied from the start since pupils need to understand what learning is. According to Martono and Yusnita (2020), mathematics is one of the courses taught from elementary school through university education.

Deductive reasoning and abstract, hierarchical notions and concepts are the focus of mathematics. Due to the hierarchical and organised nature of mathematical concepts, no phases or stages of the learning process are missed when learning mathematics (Herawati, Siroj, and Basir, 2010). As a result, studying mathematics will be accomplished quickly and effectively. due to the relationships that exist between mathematical ideas. Acquiring knowledge of mathematics is crucial, as it is indispensable in daily existence, covering both basic and intricate difficulties. In addition to taking notes and challenging authority, students studying mathematics in the

classroom are expected to be able to understand the relevance and meaning of the material taught by their teachers.

According to research by Febriani, Widada, and Herawaty (2019), there are a number of issues with mathematics education in the classroom. These include: 1) Students struggle to comprehend mathematical materials; 2) They have trouble absorbing math material; 3) Students struggle to articulate mathematical concepts in writing; 4) Students struggle to translate and interpret the meaning of symbols, bold, diagrams, pictures, and graphs with other concepts; and 5) Students struggle to relate one concept; 6) Students are unable to use the mathematical ideas they have acquired to solve an issue; 7) Students are unable to connect previously studied and upcoming topics. Indonesian students placed 73rd out of 79 participating nations in 2018 with an average PISA score of 379 and an average OECD score of 486. The average score for the Mathematics National Examination is 46.56, the lowest of all exam disciplines, according to the 2019 Ministry of Education and Culture National Exam Results Report for junior high school students. Suraji, Maimunah, and Saragih's (2018) study on students' understanding abilities also shows that students' mathematical understanding is rated as very low. Specifically, students' understanding scores are as follows: 1) approximately 2.38% of students are able to restate concepts and classify objects according to the concept; 2) approximately 4.7% of students are able to present concepts in various forms of mathematical representation; and 3) approximately 1.19% of students are able to use, utilise, choose certain procedures, and apply concepts. Then, Fajar, Kodirun, Suhar, and Arapu (2018) found that, out of 30 students, 3% fall into the high category, 10% into the medium category, and 87% into the low category, indicating that students' comprehension of mathematical concepts in material systems of linear equations is still comparatively low. I agree with Putra et al. (2018) that out of 36 students, 41.67% have poor criteria for mathematical comprehension, 30.56% have medium criteria, and 27.72% have high criteria.

In the learning process, pupils' mastery of mathematics requires attention. Students typically have less interest in learning mathematics because it is still seen as a challenging subject. According to Wardhani (Yulianty, 2019), the purpose of mathematics in the classroom is to help students: 1) understand mathematical ideas, interpret how ideas relate to one another, and apply ideas or algorithms; 2) apply reasoning based on patterns and properties, mathematical manipulations to make generalisations, gather evidence, or explain mathematical ideas and statements; 3) Solve problems, requiring the capacity to comprehend issues, create mathematical models, solve models, and evaluate the results; 4) Express concepts through tables, graphs, symbols, or other media in order to make situations or issues more clear; 5) Adopt a mindset that recognises the value of mathematics in everyday life. This includes being persistent and self-assured during problem-solving, as well as showing curiosity, care, and enthusiasm in learning the subject. In order to motivate students to learn and participate actively in the educational process, these circumstances necessitate the teacher's involvement in efforts to improve engaging teaching strategies and media.

The goal of learning mathematics is to empower pupils to use their own intelligence to build mathematical ideas or principles, allowing the ideas or principles to emerge naturally. Teachers should actively engage their students in their mathematical education on a mental, physical, and social level. When learning mathematics, students must do more independent and independent tasks in order to locate the concepts being studied. They must also recall mathematical

formulations, theories, and concepts in order to answer problems on tests. The low degree of mathematical comprehension ability is one of the elements contributing to the poor quality of mathematics learning outcomes for students (Febriani, Widada, and Herawaty, 2019).

A primary objective of mathematics education is for students to grasp the subject. Understanding mathematics is one of the knowledge-related competencies that high school students must possess, according to Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 21 of 2016 concerning content standards for primary and secondary education (Nurdin et al., 2019). Understanding is the foundation for doing mathematical operations. In order to solve arithmetic issues, every learner needs to have strong comprehension abilities. One mathematical skill that students must possess in order to acquire mathematics is mathematical understanding. With this skill, students are better able to comprehend the notion of the subject matter (Febriani, Widada, and Herawaty, 2019).

It is necessary to develop the capacity to comprehend pupils' mathematical comprehension since it aligns with the requirements of the 2013 curriculum. Since the teacher serves as a guide for the students to follow in order to grasp the required concepts, one of the goals of every lesson the teacher presents is mathematical understanding. According to Rahayu et al. (2018), a student's comprehension of mathematics is demonstrated by their capacity to retain mathematical ideas, articulate them in their own words, and use those ideas to solve problems. After that, you can connect one idea to another. According to Susanto (2014), comprehension is the capacity to interpret or make inferences from tables, facts, graphs, and other visual aids, as well as the ability to explain a situation in other words. One of the skills in studying mathematics is mathematical knowledge, which is the capacity to comprehend and provide an explanation for a scenario or an action within a category that possesses universal properties recognised in mathematics (Rahayu et al. 2018).

The way that educational units organise their learning is interactive, fun, challenging, inspiring, and motivating. It also gives students the opportunity to be active and develop their creativity and independence in ways that suit their interests, abilities, and stage of physical and mental development. According to Khasanah, Praheto, and Supiyah (2022), learning is a sequence of actions driven by an individual's fervent desire to learn new things. Not only can learning occur in formal settings, but it can also occur in non-formal and informal settings with written and unwritten norms, standards, and principles.

Teachers and students must communicate with one another during the learning process. According to Kristiana and Radia (2021), contact between all elements that are related to one another is actually necessary for the learning process. The teacher's job in the learning process is to communicate and clarify the material so that pupils can grasp and understand it. Designing and creating learning resources that can assist the learning process is essential to achieving the desired learning objectives. According to Putria, Maula, and Uswatun (2020), learning activities that can succeed and meet learning objectives are a part of the learning process. If a teacher implements innovative learning strategies, such as using students as learning centres and allowing them to interpret what they learn, then learning can be improved (Devi and Bayu, 2020).

The optimisation of learning is further supported by a variety of contemporary learning tools and resources, both in the classroom and in daily life. The evolution of technology, particularly information and communication technology, has made learning much more convenient. This has made it possible to move away from the process of presenting different types of knowledge and towards guidance in undertaking individual knowledge discovery. In addition, it is entirely feasible to shift the paradigm from the student-centred learning philosophy to the teacher-centred one.

In its most basic form, learning is a communication process meant to elicit ideas, feelings, interests, and attention from students. One approach to material generation in the learning process is media optimisation for the creation of instructional materials. Learning media is a phrase used to describe media that helps with communication throughout the learning process. Instructional media can be divided into four categories based on technical advancements: 1) print technology; 2) audio-visual technology; 3) computer-based technology; and 4) media that combines printing and computer technology. A variety of learning media, including print and book media, audio media, multimedia, interactive videos, film, video, electronic distribution systems, and books, have become more complex and computer-integrated as a result of the use of technology in education (Hosnan, 2014).

Visual media is one type of media that can be used to engage students' attention during a lesson. The use of visual media is crucial to the learning process. According to Arsyad (2017), visual media can help students comprehend concepts, improve their memory, become more engaged in the material, and make connections between the classroom and outside world. For visual aids to be effective, they must be positioned within a significant context and require student interaction in order to facilitate the learning process.

Diagrams, maps, graphs, and representational images are examples of visual forms. pictures, paintings, or photos that depict how something seems to be representational imagery. a schematic showing the material structure, organisation, and relationships between concepts. a map that displays the spatial relationships between the material content's elements. Graphs that show an overview of data or the link between a collection of images or statistics, such as tables, graphs, and charts.

According to Arsyad (2017), the following broad guidelines must be taken into account when using visual media: Make the graphics as basic as feasible by utilising cardboard, line drawings, charts, and diagrams; 2) In order to correctly carry out learning, visuals are required to emphasise target information; 3) Before giving classes unit by unit, use images to give pupils an overview of the complete subject so they can organise the knowledge; 4) To enhance memory, repeat the visual presentations for students. 5) Utilise images to highlight the concepts that differ; 6) Steer clear of uneven images; 7) Highlight precision and sharpness in every image; 8) Visuals that are projected must be readable and readable; 9) Diagrams serve as excellent visual aids while studying rather complex material; 10) To aid in information management, message components in the graphics should be emphasised and clearly differentiated from background aspects; 11) In order to provide information that is challenging to convey visually, captions for photos must be provided; 12) Colours have to be employed sensibly; 13) To draw the eye and set the components apart, colour and shade are employed.

Images, drawings, line drawings, graphs, charts, and combinations of two or more forms can all be used to visualise ideas, messages, or information that need to be explained to pupils. Photographs provide explanations by using visuals that nearly perfectly capture the essence of a thing or circumstance. Graphics, on the other hand, are an artistic and symbolic depiction of a thing or circumstance. The calibre and potency of visual materials and images determine how well visual media are used. This can only be accomplished by methodically planning, arranging the thoughts that come to mind, and applying fundamental visualisation techniques to picture things, ideas, facts, or circumstances.

Microsoft PowerPoint is an additional resource that can be utilised in the mathematical learning process. To make the content being presented more engaging, PowerPoint is utilised as a presenting tool that allows for visual input. Using PowerPoint as a teaching tool aims to improve the quality of the learning environment while also raising student engagement and positive reactions. Furthermore, you can show information in the form of eye-catching and effective presentations using PowerPoint media (Komariah, Salsabila, and Wiraningsih, 2021). Subsequently, Rusman (Setyawan and Suniati, 2018) disclosed that Microsoft PowerPoint is software that is specifically made to present multimedia programmes in an appealing manner. It is also reasonably priced, simple to produce, and requires no raw materials other than data storage devices.

Presenting educational presentation materials is a great use of Microsoft PowerPoint media. According to Sry (Satrio, Suratman, and Idjudin, 2014), Microsoft PowerPoint has the following benefits as a teaching tool: 1) Require more children to learn more about the instructional materials offered; 2) Encourage more children to play games including colours, letters, and animations, including animated text and images or photos; Information messages are: 3) easily understood by pupils visually; 4) minimal explanation by the teacher is required to explain the subject being presented; 5) can be repeated and replicated as needed; 6) can be saved as optical or magnetic data, making it practical to employ.

Drawing on the difficulties that have been presented, educators can employ visual media as a stimulating and successful teaching tool to enhance their students' comprehension of mathematics. For junior high school students' mathematics learning activities, the author decided to employ PowerPoint-assisted visual media as a teaching tool. Students can review the clear and in-depth material offered in a visual medium to refresh their understanding of the mathematical concepts. Consequently, the authors carried out research to enhance junior high school students' mathematical comprehension skills by using PowerPoint-assisted visual media in mathematics instruction.

2. Methods

This study employed a quasi-experimental methodology. The participants in this research were all SMPN 1 Pagelaran class VIII students, which was comprised of six classes. Using the purposive sampling technique, two of the six classes—class VIII C as the experimental class and class VIII D as the control class—were taken. Class VIII C has 26 pupils, and class VIII D has 26 kids. In this study, 52 pupils from classes VIII C and VIII D served as the sample. Five questions

in the form of a description served as the test used in the research to collect data. Students were the first to use this test instrument to determine its validity and reliability. It appears from the test findings that the device is suitable for use in the process of gathering research data. The experimental class and control class's pretest and posttest outcomes provided data from which the N-Gain data was derived. Descriptive and inferential statistics were used to examine the normality, homogeneity of variance, and mean differences of the N-Gain data. The experimental class received instruction in mathematics using visual media aided by PowerPoint, while the control class received instruction in mathematics using visual media aided by drawings.

3. Result and Discussion

The experimental class was taught using visual media with PowerPoint assistance. The teacher used visual media to present teaching materials, which the students could then use as references to independently create questions and figure out how to solve them. This allowed the students to change the conditions or objectives of the solved questions to create new questions of their own. In order to create actual products that can inspire student creativity and help them comprehend math concepts, the control class uses ordinary learning, which is frequently employed by SMPN 1 Pagelaran teachers. The teacher merely serves as a facilitator, assessing the work that the students do on the projects they are working on. Following the completion of all exercises, a posttest is administered to assess students' comprehension of mathematics following treatment. Since the post-tests administered to the two classes are identical, it is possible to compare the students' understanding of mathematics in the experimental and control groups using the results.

This study's data comes from quantitative assessments of participants' mathematics comprehension skills. Following acquisition, the data is examined in order to provide descriptions and interpretations. Analysis of the quantitative data was done for both the control and experimental classes. The process of managing quantitative data involves two main steps: 1) Testing the statistical prerequisites required to support the submission of hypotheses, such as the homogeneity and normality tests; 2) Testing whether differences exist between classes and improving the capacity to comprehend mathematics in line with the proposed hypothesis. The pre- and post-test results that were given to the control and experimental classes are the data that need to be processed for this study. Following data collection, the information is processed and examined to provide an answer to the hypothesis that has been put forth. Table 1 below displays the pretest data analysis results.

Table 1
Pretest Data Analysis Results

Class Group	N	$\bar{x}$	S	S^2	Lowest Value	The highest score
Experiment	26	21,53	8,67	74,91	5	35
Control	26	14,73	8,11	65,77	5	35

Table 1 demonstrates that, in the experimental class, students' mathematical understanding abilities prior to receiving visual assistance through PowerPoint had an average pretest value of 21.53, whereas in the control class, students' mathematical understanding abilities prior to

receiving no visual assistance had an average pretest value of 14,73. The experimental class students' variance value was larger than the control class students', suggesting that the experimental class students' starting abilities were more erratic. Table 2 below displays the findings from the data analysis of the posttest.

Table 2
Posttest Data Analysis Results

Class Group	N	$\bar{x}$	S	S^2	Lowest Value	The highest score
Experiment	26	78,46	10,25	105,06	60	98
Control	26	67,38	11,43	130,64	45	85

In the experimental class, students' average score for mathematical understanding after receiving visual media assistance through PowerPoint was 78.46, according to Table 2. In the control class, students' average score for mathematical understanding after receiving no visual media assistance through PowerPoint was 67.38. enhancing the experimental class pupils' capacity for mathematical comprehension, as seen in Diagram 1 below.

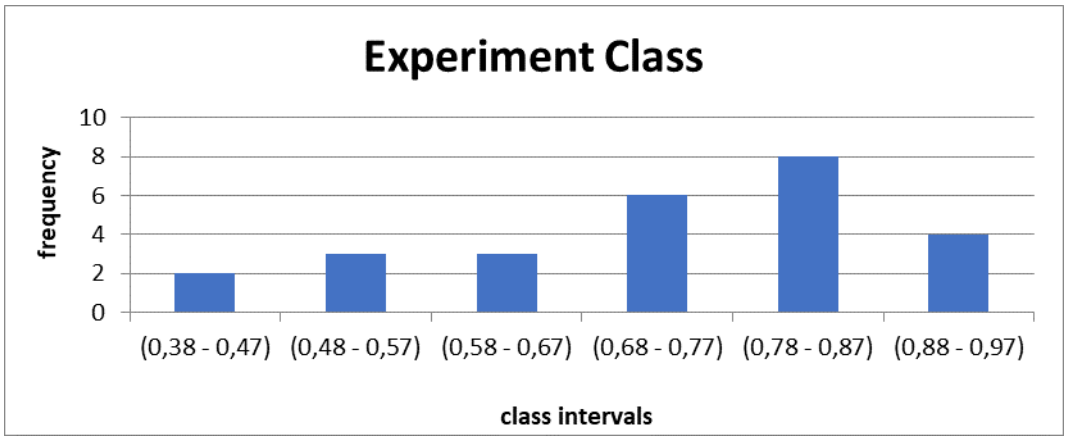

Diagram 1. Experimental Class N-Gain Score

Diagram 1 illustrates that the experimental class had a high N-Gain rise of 0.97, whereas the experimental class had a low N-Gain classification with an N-Gain increase of 0.38–0.47. Diagram 2 below illustrates how the pupils in the control class have improved their ability to understand mathematics.

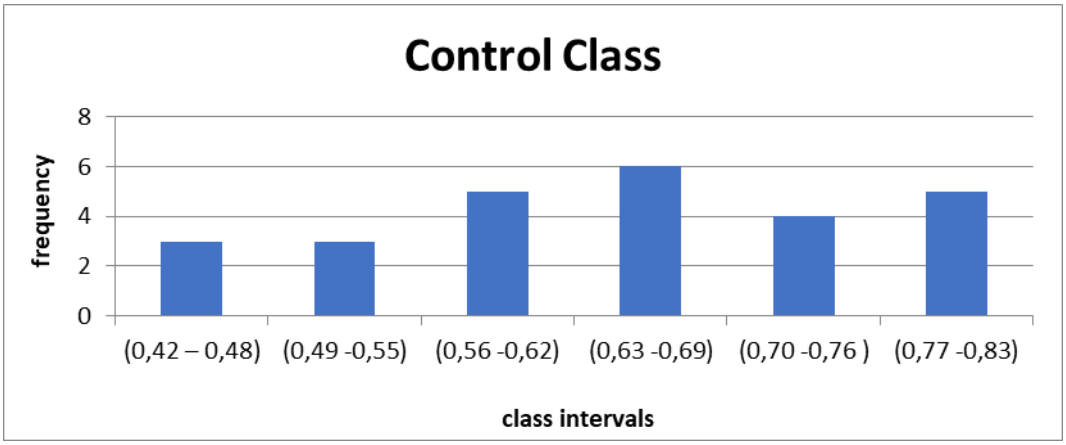

Diagram 2. Control Class N-Gain Score

Diagram 2 illustrates that with poor classification, the lowest N-Gain value is 0.42-0.48 and the greatest N-Gain value for the control class is 0.83. To obtain a lucid image of the experimental class and control class students' N-Gain data, refer to Table 3 below.

Table 3
Description of the N-Gain Value

Sample (class)	Subject (N)	Minimum Score	Max Score	Means	Standard Deviation	Varians (S^2)
Experiment	26	0.38	0.97	0.72	0.15	0.022
Control	26	0.42	0.83	0.64	0.11	0.012

The experimental class's mean N-Gain score is 0.72, whereas the control class's is 0.64, as indicated by Table 3. As the control class also has a high classification, the N-Gain experimental class has a high N-Gain improvement classification. The experimental scores and the control class have the same variance, as seen by the experimental class's 0.022 standard deviation and the control class's 0.012 standard deviation.

When the chi square test chi-square was used to determine the normality of the N-Gain data for the experimental class, the result was chi-square stat = 6.62. This value was compared to chi-square table for Dk = k – 1 = 6 – 1 = 5, yielding chi-square table = 11.1. The N-Gain funds improve students' capacity to have a regularly distributed mathematical comprehension of the experimental class, as demonstrated by the comparison of chi-square count with chi-square table, or $6.62 \leq 11.1$. When the Chi square test chi-square was used to evaluate the normality of the N-Gain data for the control class, the result was chi-square count = 8.18. This value was compared to chi-square table for Dk = k – 1 = 6 – 1 = 5, yielding chi-square table = 11.1. The normal distribution of the N-Gain data for enhancing the mathematics comprehension skills of control class pupils is demonstrated by comparing chi-square stat with chi-square table, or $8.18 \leq 11.1$.

By comparing the biggest and lowest variance, the F test was used to determine whether the N-Gain data were homogeneous. Table 4 below displays the findings of the computation of the variance value of the N-Gain data for the two classes:

Table 4
N-Gain Data Variance Value

Sample variance value	Variable type: comparison of experimental class and control class pretest values	
	Experiment class (X_1)	Control Class (X_2)
S	0,12	0,13
S^2	0,014	0,016
N	25	25

Table 4 demonstrates that the computation yielded a significant rate of $\alpha = 0.05$ and $F_{stat} = 1.14$. When we compare the F_{stat} and F_{table} values with the largest variance represented by dk quantifier = n – 1 = 25 – 1 = 24 and the smallest variance represented by dk denominator = n – 1 = 25 – 1 = 24 (for the smallest variance), we obtain $F_{table} = 1.98$. $F_{stat} < F_{table}$, or 1.14 < 1.98, indicates the homogeneity of the N-Gain data.

The purpose of the post-test administered to both the experimental and control groups is to determine whether there is a difference in the growth in the mathematical understanding abilities of the students in the experimental group who use visual aids from PowerPoint and the students in the control group who do not. The average difference test is conducted because the difference in improving mathematical comprehension indicates that the treatment is having an impact. The data is normally distributed and the variance is homogeneous, as shown by the outcomes of the statistical precondition test for the N-Gain data; so, parametric statistics were employed.

tstat = 2.33 for $\alpha = 0.05$ and dk = n1 + n2 – 2 = 26 + 26 – 2 = 50 were determined based on the computations. the t_{table} was 1.6821. It is determined that $t_{stat} > t_{table}$, or 3.54 > 1.6821, by comparing t_{stat} with t_{table}. There is a treatment effect, which means that while H_0 is rejected, H_1 is accepted-that is, pupils in the experimental class have improved their average mathematical comprehension more than those in the control group. Therefore, when learning mathematics at SMPN 1 Pagelaran, the usage of PowerPoint-assisted visual media can enhance students' mathematical understanding abilities. Table 5 below displays the findings from the study of the N-Gain data.

Table 5
Recapitulation of N-Gain Data Processing

Analysis	Results	Decision	Conclusion
Experimental class normality test	$x^2_{stat} = 6,62$ $x^2_{table} = 11,1$	$x^2_{stat} < x^2_{table}$	The N-Gain data for the experimental class are normally distributed.
Control class normality test	$x^2_{stat} = 8,18$ $x^2_{table} = 11,1$	$x^2_{stat} < x^2_{table}$	The N-Gain data for the control class is normally distributed.

Homogeneity Test	$F_{stat} = 1,14$ $F_{table} = 1,96$	$x^2_{stat} < x^2_{table}$	The variance of the N-Gain data is homogeneous.
t test	$t_{stat} = 3,54$ $t_{table} = 1,6821$	$F_{stat} > F_{table}$	There is an increase in the ability to solve mathematical problems.

Table 5 presents the variation in the enhancement of mathematical comprehension skills between the students in the experimental and control groups. With the average student in the experimental class having an N-Gain acquisition of 0.72 and the average student in the control class having an acquisition of 0.64, it can be concluded that learning with visual media aided by PowerPoint has an effect on increasing students' mathematical understanding abilities. This difference suggests that the treatment provided has an effect.

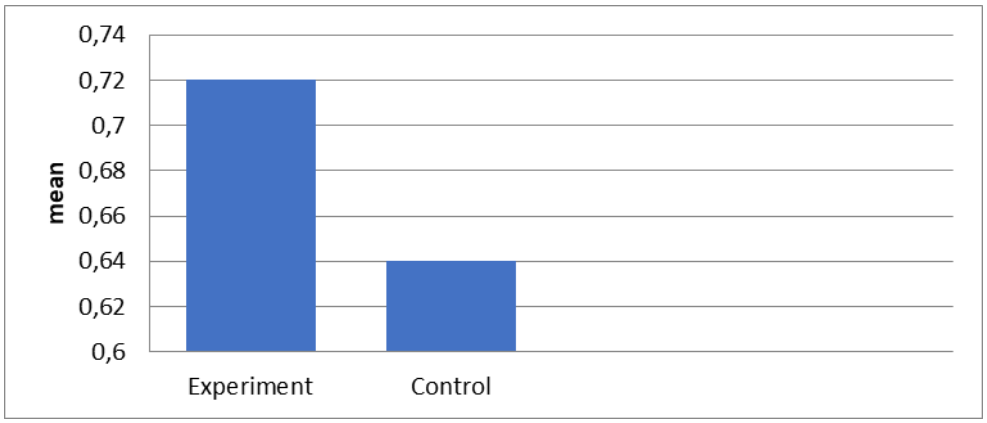

Diagram 3. Average N-Gain Value

Diagram 3 illustrates that the experimental class's average score is higher than that of the control group. This demonstrates that, in comparison to the control class, the experimental class's therapy is evident in the improvement in the students' mathematics comprehension skills. These findings support the notion that visual materials aided by PowerPoint might raise students' proficiency in mathematical comprehension. The purpose of this study was to determine whether junior high school students' use of PowerPoint-assisted visual media improved their grasp of mathematics. Research data is gathered in the form of N-Gain values utilising tested research tools. After then, this data is processed to address the previously stated study topics. The two courses received distinct instruction during the learning process: the experimental class received instruction using visual media aided by PowerPoint, whereas the control class received instruction without the use of media. Comparing the value of N-Gain as the result of the administered therapy allows for the determination of treatment differences.

When students worked on posttest problems and produced satisfactory results in comparison to their peers, the N-Gain score indicates an improvement in students' mathematics comprehension after instruction in both classes. This demonstrates that kids' capacity for mathematical understanding has improved over time. To obtain more believable findings, this N-Gain value is

subsequently statistically tested. The results of the t-test indicated that there was a difference between the experimental and control groups' increases in students' mathematical understanding abilities, with a value of $t_{count} > t_{table}$. The pupils in the experimental class who served as the study's subjects generally felt that mastering mathematics was a worthwhile endeavour. This is evident from the students' genuine interest in and commitment to engaging in the mathematics learning process, as evidenced by their passionate responses throughout the process. Overall, the use of visual media in conjunction with PowerPoint to support learning is doing well, according to research findings on student activities. Even when students are still tough to condition and appear confused since the researcher is presenting the content using different media than normal, all stages of the students' learning activities can occur sequentially in the meeting. But with consistent instruction, kids eventually grow acclimated to the media employed.

When students worked on posttest problems and produced satisfactory results in comparison to their pre-test scores, progress was evident. This demonstrates an improvement in the pupils' grasp of mathematics with the use of visual aids and PowerPoint. According to the study's findings, experimental class students can engage in learning effectively. This is demonstrated by their use of PowerPoint-assisted visual aids, which improves class VIII students' comprehension of mathematics at SMPN 1 Pagelaran. Even though students must think, the learning process is still traditional with a reliance on the teacher's explanations. However, preparing the content for PowerPoint-based visual learning necessitates a lot of work on the part of teachers; therefore, PowerPoint must be made as engaging as possible to keep students' attention throughout the learning process. In addition, proper equipment is necessary for schools to ensure that the learning process runs smoothly.

4. Conclusion

The goal of using PowerPoint to create visual media is to assist students in comprehending mathematics better, particularly when it comes to the topic of planar figures in class VIII SMPN 1 Pagelaran. Students have a good attitude towards learning mathematics, particularly geometry subjects, after they have finished their lessons. With the aid of PowerPoint and visual media, students generally exhibit a positive attitude towards all facets of learning. It is evident that employing visual media in conjunction with Power Point has resulted in a notable improvement. This is demonstrated by the researchers' t test results, which indicated that $t_{stat} > t_{tabel}$. As a result, H_0 was rejected and H_1 was accepted. This indicates that class VIII students at SMPN 1 Performance were able to comprehend mathematical concepts on the topic of building space more readily when they used visual aids like PowerPoint. Students find it easier to understand geometric principles when learning with visual aids like PowerPoint since the graphics are more clear. The teacher will thus have more time to broaden the delivery of the lesson material because the procedure of giving the material will be shorter. Naturally, during the learning process, geometric drawings must be made, which takes a considerable amount of time as the teacher explains the subject. Teachers can more easily explain geometric concepts to pupils when they use visual aids like PowerPoint, and students can view illustrations with more clarity.

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