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Achievement of Mathematics Teachers on Production of Computer Based Software Package for Teaching And Learning of Mathematics

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Abstract: The research was carried out to determine the achievement of mathematics teachers in the production of computer-based software packages for teaching and learning mathematics. Fifty (50) mathematics teachers of which twenty (20) were from primary schools, fifteen (15) were from secondary schools, and fifteen (15) were lecturers from tertiary institutions, were selected for this study. They were trained on computer-based software package production for twenty-one (21) days and rated. The result of the analysis using ANOVA and t-test at 0.05 level of significance, shows that there was no significant difference in achievement of the teacher in computer-based software package production. Primary school teachers had a mean achievement score of 73%, secondary 72%, and lecturers 75%. Males had 75.6%, females 71.5%, so, t-ratio showed no gender difference at 0.05 level of significance. It is recommended that computer-based software production by teachers should be encouraged.

Keywords: Mathematics; Teachers; Computer-Based Software Package; Production; Training.

A. Introduction

It has become obvious that the use of computer in teaching and learning have contributed immensely to alleviate the problem of understanding and mastery. Computer has played a huge role in making learning easy. Teachers who have been able to lay hand on adequate and suitable software for teacher always find it easy to communicate the institutional content to learners in such a way that they attend mastersy with ease. The joy of a good teacher is in having desirable result. This is made possible with use of computer. Rouse (2022) emphasized that computer based learning has many benefits such as help users to learn at their own pace, being very interactive, learning at one desired time, having that which is globally accepted and having the ability to accommodate traditional method. Rouse (2022) stated that knowledge-based training and assessments, simulation and drill are effected prudently with the use of computer. This make the use of computer in teaching and learning very relevant (Ingram, 1985). Computer software package was developed and used in teaching English Language and it was discovered that the product was easy to duplicate, contains elaborate learning material, pictures and displace design which make the students more enthusiastic and interested, while the exercises

were more fascinating (Rohmar, 2019). The use of computer in teaching has helped to remove the complexity in instructional delivery (Garba, Umar and Hu, 2010, Vann, Mernenboer, 2002)

The most serious obstacles to the implementation of computer assisted instruction in the school systems include non-availability of facilities and lack of affordable and relevant software packages. The relevant package to use and carry out instructional delivery are scarce. There are several models that have been presented to be used in the development of computer-based instructional packages. Rosenthat (197s6) presented a model that contained segment and phases of instruction which includes administration and coordination, development of project team, definition of project scope and objectives, development of program for system design and conducting of orientation meeting. Evaluating this model before implementing computer-based instruction makes it look herculean. Chen and Shen (1989) cited "waterfall models as the key to help make the software adaptable to users and satisfy their need. Similarly, Pappas (2014) instructed that production of computer-based software package has been the bends in computer based instructional delivery. Duliah and Muchtar (2019) enunciated the advantages computer assisted instruction and proposed the use of conceptual model which comprises introduction, presentation of information, question and responses, feedbacks, question and responses, feedback and responses, judging and responses, remedial, case exercise and finally closing.

Software has been developed with various languages for teaching and learning but the process seems complex and clumsy which make it difficult for spread and effective usage hence some of the packages are short life. Software develop by Beitez(2018), Garbrar and Hu (2010), Michael and Igenewari (2022) has exciting result but were produced with peculiarity for specific instruction and cannot be generally applied or use in wider perspectives.

This lapses make it obvious that there should be a need to produce software that can be applied in all areas when need arises. It has become pertinent that teachers should know how to produce software for the instructional usage. It cannot be anticipate that instructional software can be sourced from market for every topic that are to be taught.

This study is carried to train mathematics teachers on the production of instruction software using reality model. The reality model provide direction which the teachers can always follow to produce software as much as they chose to and in every topics the need to use.

The major problem that hampered the proper implementation of computer-based instructional delivery in mathematics is the available of relevant software at affordable cost. Though the use of computer in teaching mathematics at all level has been accepted as a necessary breakthrough in the fields of educational development, it has not been possible to be widely applied due to the fact that the mathematics teacher lack the skills to use the packages and also relevant packages are not available in all the topics, therefore the study trained the mathematics teachers to produce the software packages themselves. Their achievement in the production of the packages are evaluated and correction given. This will give the mathematics teachers the skills and adept of production of computer-based software that are relevant to the topics in the scheme of work and syllabi.

The study will make computer-based instruction packages that relevant to the scheme and syllabi readily available for use in teaching mathematics at all level of education and as a result lead to improvement in students' achievement and general learning outcome in

mathematics. Other subjects, courses and disciplines will also benefit if they will join the mathematics teachers.

Considering that computer-based software has huge positive impact on teaching and learning and general instructional delivery when it is applied, it becomes necessary that the product should be available for teacher and learner as at any time there is need to apply. This cannot be except the teachers can produce the software for their usage and that of the learners. The achievement of mathematics teachers in software production using reality model is evaluated and reported in this study. It has positive and promising result.

The relevance and essence of computer in teaching and learning has been enunciated by several researchers but getting the relevant packages for implementation of the computer assisted instruction when needed has always been the clog in the wheel of progress of the usage of computer-based packages in teaching and learning. This paper is aim at alleviating the problems associated with the production of instructional software for teaching and learning of mathematics by training mathematics teachers for production of software that can readily be used for that purpose. It prepares mathematics teacher for the production of software which can be used in the teaching of mathematics. In other words, it promotes software improvisation. The teachers are trained to write program that can run for the purpose of utilization in mathematics classroom. The achievement of the teachers and their programs are reported in this paper.

B. Methods

The study is an experiment which was carried out with mathematics teachers in primary schools, secondary schools and tertiary institutions in Rivers State of Nigeria. They were purposively selected for the study on the bases of their willingness to participate, to be trained and their achievement in production of computer-based software for teaching mathematics using BASIC and python programming languages evaluated.

1. Population of Study

The population of the study include all mathematics teachers in the public and private institutions (schools) in Rivers State of Nigeria. The selection includes primary school teachers, secondary school teachers, lecturers in College of Education, Polytechnics and Universities. The population of study cut across all the mathematics teachers teaching at primary schools, secondary schools and tertiary institution in the State. A total of 2,575 mathematics teachers made up the population.

2. Sampling technique

Positively random sampling procedure was used for the study. The participant were selected on the order of first come first serve. The teachers who responded to the invitation early and accepted to participate in the three weeks training were the one that were chosen.

3. Participant

Fifty (50) mathematics teachers participated in the study. They were thirty (30) males and twenty (20) female mathematics teachers. Twenty (20) teachers were invited from primary schools, fifteen (15) from secondary schools and tertiary institutions. There was no criteria for the selection. The teachers were used for the study based on their willingness to participate. The number of participants was restricted to 50 based on first come first serve order. The fact

is that those who accepted the invitation early were the ones that were used. The reason for selecting only fifty participants was because it was training based. They were taught and evaluated for a period of three weeks hence only one stream of the participants was used for the purpose of perfection and good management. They were all trained in the Federal College of Education (Technical), Omoku, Computer laboratory. Among the participants were twenty (20) female and thirty (30) male mathematics teachers.

4. Instrumentation

The instruments used in the study includes

(1) Training manual
(2) Program packages
(3) Participant involvement checklist
(4) Training checklist
(5) Participants trial test items
(6) Participant assessment checklist

5. Training manual

This is a set of rule for the training. It states categorically the time each aspect as the training takes place. The introduction takes about ten (10) minutes. Familiarization with computer and master of the keyboards twenty (20) minutes introduction to programming. Thirty (30) minutes interaction with the programmers and the technicians. thirty minutes and practical exercise, thirty (30) minute. This formed the two hours training for the first day.

The second day of the training was on introduction to BASIC programming. Which the participants were taught how to write BASIC programming language. The question and answer session was on the different technicalities of writing BASIC programming and producing software with it. The practical session was also included for forty-five minutes. The session end with correction of trainees programs and assignment.

The third day continued with BASIC programming. The technical session was one hour while the practical session was one hour which ended with correction of trainees programs and assignments.

Day four was rehearsal of BASIC programming and package production with BASIC.

The fifth day, day five was introduction to python programming. It was one hour theoretical and practical work was for one hour. The ended with assignment on python programming language.

The sixth day, day six was practical programming with python which took one hour forty-five minutes, with exception of the fifteen minutes of introduction, it ended with assignment.

The seventh day, day seven was animation programming. One-hour introduction and theoretical work on animation and another one hour was practical programming and production of two dimension and three-dimension objects.

The eight day was mixed with program packages writing. Programing packages with BASIC and python while the ninth day was introduction to mathematics program packages production sample packages.

The tenth day was practical package production using topics from the scheme of work. The eleventh day was trial package validation while the twelfth day was implementation of the trial package. The package was short instruction produced by the teachers. The thirteen and

fourteen day were for revision. The third week was practical implementation of the packages, marking of pre and posttest of students taught with the trial packages and collection of results on the achievement of the participant as well as closing of the training workshop.

6. Program packages

The training instructions were package in BASIC and python. They were delivered through local area network (LAN) to the different computer which the trainees were using with screen and multimedia facility used for explanations and interactions. The packages were properly validated. Other programming packaging in mathematics instructions at the three levels of education were also shown and used as examples for discussion.

7. Trainees' involvement and commitment checklist

The checklist contains the rating of activities of the trainees during the lesson. It was presented as in the table below, for each of the participants. The rating was done by technicians and research assistants.

Table 1. Participants checklist

S/N	ITEMS	1-10	11-20	21-30	31-40	41-50
1.	Punctuality					
2.	Attentiveness					
3.	Contributions					
4.	Asking questions					
5.	Answered questions					
6.	Ability to use computer					
7.	Ability to write codes					
8.	Ability to interpret codes					
9.	Logical production of ideas					
10.	Good program package on chosen topic					

The above was the individual checklist for each of the participants during learning.

8. Training Checklist

This is a general checklist that was used to monitor the rate which the training was progressing and serving each aspect that was required.

Table 2. Training Checklist

S/N	ITEMS	1	2	3	4	5	6	7	8	9	10
1.	Proper introduction										
2.	Proper using of package										
3.	Relevance to trainees need										
4.	Carrying trainees along										
5.	Helping the trainees to mastery concepts										
6.	Enabling the trainees to meet objectives										
7.	Trainees able to produce packages										
8.	Trainees package meeting the objectives										
9.	Adequacy of trainees packages										
10.	Learners learning outcome improvement with trained package										

9. Participant Trial Test Items

This comprised of the pre-test and posttest items which the trainees used to implement their packages. They were set on the topic which their packages were produced and administered before and after their experiments.

10. Participant Achievement Checklist

This is where items which the participants were scored were evaluated.

Table 3. Participant Achievement Checklist

S/N	ITEMS	1	2	3	4	5	6	7	8	9	10
1.	Involvement in the training										
2.	Ability to write program										
3.	Production of workable package										
4.	Relevant of package to the object to the topics										
5.	Acceptance of the package by learners										
6.	Achievement of objectives through the package										
7.	Proper usage of the package										
8.	Evaluation of the objective via the package										
9.	General assessment of the trainee product										
10.	Learners assessment of trainees product										

11. Research Procedure

The research was carried by giving invitation to all the mathematics teachers in the state. The fifty (50) participant were selected from the list of those who responded to the invitation in the order of first come first serve. The training was carried out in the computer laboratory of the Federal College of Education (Technical) with the help of two programmers and four technicians and five other research assistants. The trainees were taught how to produce computer-based instructional packages in mathematics.

After the teaching, they produced their packages and test run them. Their packages were in different topics in mathematics taught at the level which they were teaching. They used the packages to evaluate their learners learning outcomes to determine the success of the training. They were evaluated using the checklist. The data were collected using the checklists.

12. Training Model

The efficiency skewed four prompt model encompasses four key agents that drive the activities namely: instruction, programmer, teachers and learners, was used for the study.

The instructional contents were first examined by both the teacher and the programmer, then the nature of the software package was decided by flowcharting the component and processes. It from here that the programming language or languages were chosen. Thereafter the instructional content, the subject matter that will be presented were keyed into the package. Flexibility, adaptability, suitability (relevance), acceptability (meeting the learners needs), adequacy and durability of the packages were considered as very important elements of functional ability of the packages. The packages were exposed to learners' appraisal in order to seek their satisfaction in trail with a smaller group, a smaller group of the contemporaries which the package is produced for. It is at this point the package can be considered efficient. This give rise to "efficiency skewed four prompt model" for production of computer-based package for teaching and learning mathematics.

The training was done based on "efficiency skewed four prompt model" termed REALITY MODEL given below

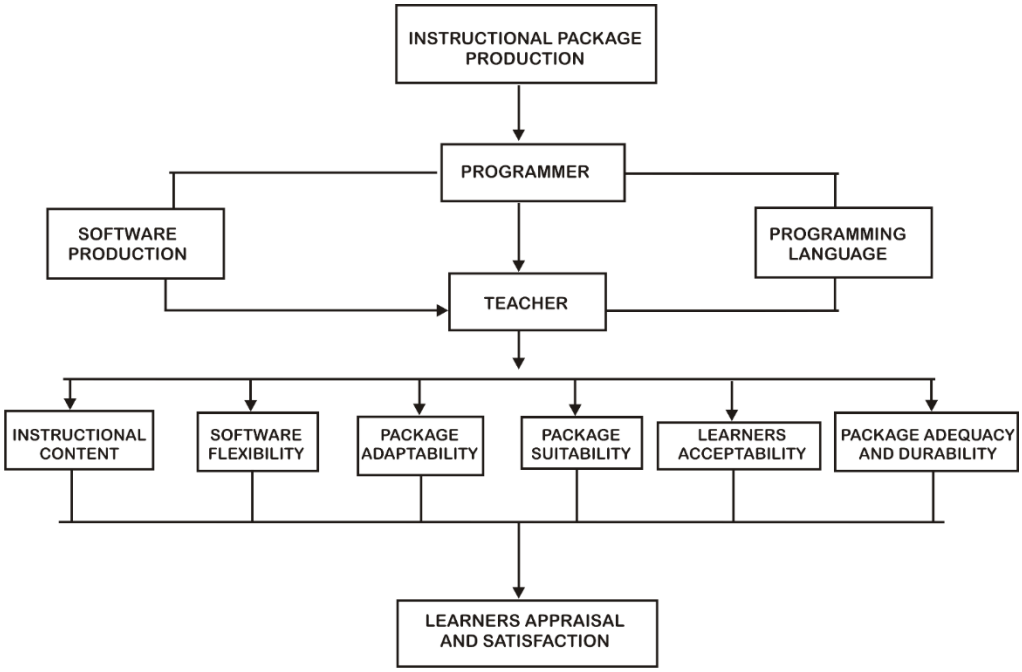

Figure 1. Efficiency Skewed Four Prompt Model

C. Results and Discussion

The hypotheses were tested using Analysis of Variance (ANOVA) with Scheffe' correction for the difference between groups while t-test were used to determine difference between genders. All the hypotheses were tested at 0.05 level of significance.

1. Hypothesis I

There is no significant difference in the achievement of mathematics teachers in the production of computer-based software for teaching and learning mathematics.

The result of data analysis is given in the ANOVA table, Table IV below.

Table 4. ANOVA Table for Achievement of Mathematics Teachers on the Production of Computer-Based Software Package for Teaching and Learning Mathematics

Source of Variation	Sum of Square	Degree of Freedom	Mean Square	F	Decision
Between	70.5	2	35.25	0.75	Accept
Within	2,112	47	46.93		
Total	**2,182.5**				

The critical value for $F^2_{47} = 3.23$ which is higher than the calculated value 0.75

With a mean achievement score of 73% for twenty (20) primary school mathematics teachers 72% for fifteen mathematics in secondary schools teachers and 75% for fifteen (15) lecturers from tertiary institutions and calculated value of $F^2_{47} = 0.75 < 3.25$ which is the critical value, this shows that there is no significant difference in the achievement of mathematics teachers in production of computer-based packages for teaching and learning mathematics, testing at 0.05 level of significance. Hence hypothesis I is accepted.

2. Hypothesis II

There is no significant gender difference in the achievement of mathematics teacher in the production of computer-based packages for teaching and learning mathematics.

The result of data analysis is shown in Table V below.

Table 5. t-ratio of the achievement of mathematics teachers in production of computer-based software package for teaching and learning mathematics.

Gender	Number N	Mean $\bar{x}$	Standard Deviation	Degree of Freedom	t-ratio	Critical Value	Decision
Male	30	75.6	20.32	48	0.63	2.02	Accept
Female	20	71.5	24.68				

The result of the data analysis presented in the Table V above shows that there is no significant gender difference in the achievement of mathematics teacher in production of computer-based software for teaching and learning mathematics. Hence hypothesis II is accepted. The calculated value of t-ratio, t = 0.63 < 2.02 which is the critical value confirm the existence of no significant gender difference in the achievement.

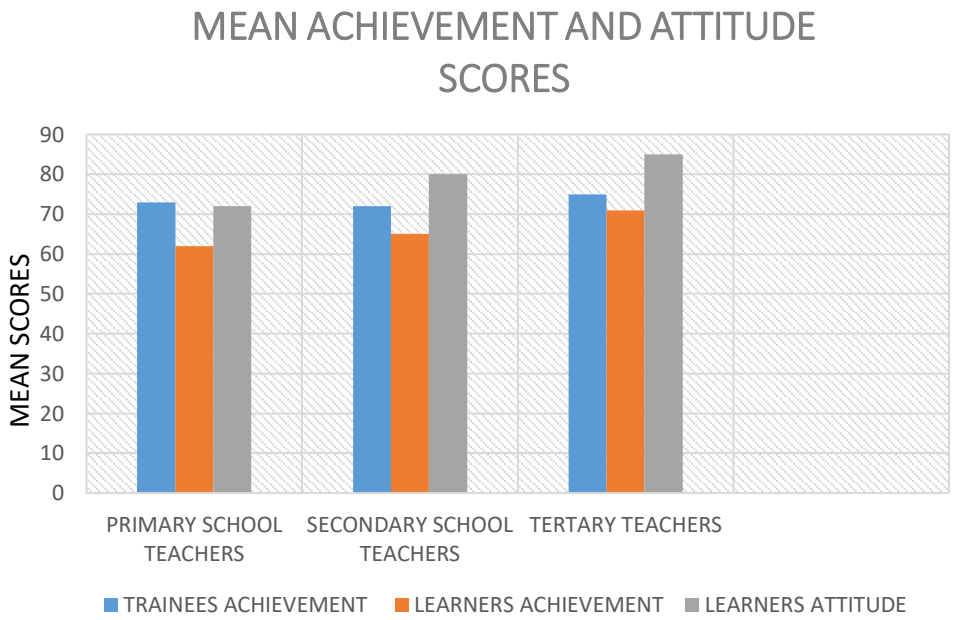

Figure 2: Achievement of trainees and the learning outcomes (achievement and attitude) of students taught with improved computer – based packages

Figure 2 gives the man scores of the achievement of the trainees and that of the achievement and attitude of students used in package implementation.

3. Discussion

The main objective of this research is to reveal the possibility of making computer-based packages for the teaching and learning mathematics available everywhere and as at when needed, at the lowest cost or as cheap as possible, since computer-based software are seen to be adequate, essential and efficient in promoting quality delivery of instruction and learning with ease (Rouse, 2022; Michael and Igenewaru, 2022; Rohmar, 2019). The paper report a study which the researcher undertook to train mathematics teachers in the production of computer-based software packages on the topics in the curriculum or scheme of work which for the level which they are teaching. Fifty (50) mathematics teachers, included were twenty (20) from primary schools, fifteen (15) from secondary schools and fifteen (15) from tertiary institutions (lecturers), all teaching mathematics were used for the study. The result shows that there was no significant difference in their achievement in software production. All the participants were scored using a suitable checklist developed by the researcher and properly

validated by experts. The achievement and general learning outcome of the learners who benefitted from their trial software were also evaluated and were noted to improved admirably. All the participants recorded mean score of above seventy percent (70%) in the general achievement. The mean score of the primary school teachers was 73%, secondary school teachers 72% and lecturers 75%. The result of ANOVA, f - test at 0.05 level of significance showed that there was no significant difference in the achievement across the group.

The participant (trainers) comprised twenty (20) females and thirty (30) males mathematics teachers. There was need to examine whether there was comparably any significant gender difference in the achievement of the trainees using t-tests. The result showed there was no significant difference between the achievement of male and female participants. All the participants produced workable and efficient software packages which were used to harnessed good instructional delivery that were highly rated.

As a result, teacher produced computer-based software packaged should be encouraged by training the teachers to write programs for their use and that of their students and pupils so that they can learn effectively with the packages.

The research was carried out to determine the achievement of mathematics teachers in production of computer-based software package for teaching mathematics. The participant comprised of fifty (50) mathematics teachers who were trained for twenty-one (21) consecutive days without break. The result reveals that there was no significant difference in their achievement in the production of the computer-based packages for teaching and mathematics. All the participant had good scores. A mean achievement of 73% for 20 primary school teachers, 72% for 15 secondary school teachers and 75% for lecturers from tertiary institutions. This shows that all the participant has good scores. There was also no significant gender difference in achievement as the 20 female and 30 male mathematics teachers with mean score of 71.5% females as against 75.6% for males. The training of teachers for the production of software should be highly encouraged. The efficiency skewed four prompt model is a good source of guide for such training and package production.

D. Conclusion

The preparation of teachers for production of computer-based software package for teaching and learning mathematics was the focus of this research. The result showed that there was no significant difference in the achievement of mathematics teachers in computer-based software package production across the three level of education – primary, secondary and tertiary. All the participant achieved above 70% mean scores. Both male and female mathematics teachers achievement in the computer-based software package production were high and was not significantly different. The use of efficiency skewed four prompt model enhance good result for training. Teacher made computer-based package should be encouraged.

Based on the findings this study it is recommended that:

(1) Teachers should be trained on the production of computer-based software package for teaching and learning.

(2) The training should be done by: (a) Teachers themselves involving computer programmers to help them, (b) School authorities sponsoring the teachers for the training,

(c) The Government, (d) Community, (e) Donor agencies, (f) Philanthropist, (g) International organization like UNESCO

(3) The use of teacher made computer software package should be encourage to reduce scarcity of software packages for effective teaching and learning.

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Implementation of Discovery Learning Assisted by Pythagorean Puzzle to Improve Mathematical Problem-Solving Ability

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Abstract: Mathematical problem-solving ability is one of the problems of mathematics learning. Researchers applied the discovery method assisted by learning media which was one of the alternatives to improve mathematical problem-solving ability, namely the discovery learning model assisted by the Pythagorean Puzzle. This study aimed to determine the effectiveness of discovery learning assisted by the Pythagorean Puzzle in improving the mathematical problem-solving ability of the eighth-grade students of MTs Muhammadiyah 01 Purbalingga. This research was a quasi-experiment research with a quantitative approach. The population in this study were students of the eighth grade at MTs Muhammadiyah 01 Purbalingga which consisted of 163 students. The samples of this study were the students of VIII C which consisted of 22 students in the Experimental Class and the students of VIII D which consisted of 22 students in the Control class. Data collection in this study used instruments in the form of observations and tests of mathematical problem-solving skills. Based on the analysis obtained, discovery learning assisted by Pythagorean Puzzle was implemented very well. The results of data analysis using the T-test, and post-test comparison test obtained sig (2-tailed) of 0.000 < 0.05, which showed that there was a difference in the average experimental class and control class. So, it can be concluded that the implementation of discovery learning assisted by the Pythagorean Puzzle was effective in improving the mathematical problem-solving skills of eighth-grade students of MTs Muhammadiyah 01 Purbalingga.

Keywords: Discovery Learning; Mathematical; Problem-Solving; Puzzle; Pythagorean.

A. Introduction

Education is an effort to provide guidance or help in developing the physical and spiritual potential given by adults to students to achieve the goal that students are able to carry out their life tasks independently (Hidayat, MA dan Abdillah, 2019). Meanwhile, according to the Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, education is a basic and planned effort to create an atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state. So, we can mean that education is a learning process that has the aim of improving personal quality.

Mathematics is the study of abstract concepts such as numbers, formulas, and structures, and uses logic and deduction methods to solve problems. Mathematics is used to explain and

understand natural and human phenomena, as well as solve problems in other fields of science, such as physics, economics, and technology (Sadewo et al., 2022). Mathematics is a discipline that may be uniquely based solely on texts and concepts, which do not describe or refer to the world of experience except indirectly (Siagian, 2016).

Mathematics is not a static discipline consisting of a large set of concepts and skills that must be mastered in sequence but is a dynamic discipline consisting of a collection of interrelated signs and symbols, rules for the use of these representations, and problem situations that have led to the discovery of these signs and symbols, and strategies for investigating and solving problems that can be represented by these signs and symbols (Romberg, 2003). In addition, the availability and use of new technologies change, in fundamental ways, the problem situations, methods of representation, and strategies used.

Mathematics learning is one of the small and most important parts of the mathematics education process. Mathematics learning in Indonesia itself has been applied to start from the kindergarten level (TK) to the college level. At the Junior High School (SMP) level, there are several components that are actively involved including educators, students, the environment, facilities and infrastructure, and other components. Problems in learning mathematics, especially in Indonesia, are caused by several factors. These factors come from students and teachers. One of the teacher factors that can cause problems in learning mathematics is that teachers lack mastery of learning models, learning approaches, and even learning media that are appropriate for use in different materials and classes.

Based on the results of preliminary observations conducted at MTs Muhammadiyah 01 Purbalingga, it is known from the results of the first daily test of arithmetic and geometric sequence material in the form of essay questions, several classes still have difficulty solving the problem. The VIII grade mathematics teacher said that the mathematical problem-solving ability of VIII grade students of MTs Muhammadiyah 01 Purbalingga was still relatively low, even throughout the material not only arithmetic and geometric series material. Various ways have been implemented by teachers to improve students' abilities. However, teachers have not found a model that is suitable and attractive to students. And the limitations of learning media are also an obstacle for teachers in delivering math material. Many learning models are already popular. One of the learning methods that is often used in education is called discovery learning (In'am & Hajar, 2017).

The discovery learning model is a learning that is based on the discovery of real problems or real situations that are concrete so that they are easier to visualize and connect (Svinicki, 1998). In addition, the discovery learning model means a learning model that uses an approach that refers to the view that learning is a student-centered physical and mental activity (Artanti & Lestari, 2017). The model has advantages including students being active in learning because this learning model requires students to be active in the learning process. Students find it easier to understand concepts by finding them themselves than getting concepts from books. In this learning model, teacher activity greatly influences student activity (Resnani, 2019). Therefore, many researchers use the model in learning.

The previous research conducted by Padrul and Amirul said that the discovery learning model can improve students' mathematical problem-solving skills on cube and beam material (Jana & Fahmawati, 2020). Furthermore, in research conducted by Ani, et al, using a learning model and coupled with Microsoft Excel media can improve statistical problem solving skills

(Sasmita et al., 2019). Not only implementing the learning model, but this research will also use Pythagorean puzzle learning media where the media aims to facilitate students in understanding Pythagorean material.

The media has also been applied in previous studies. Research conducted by Devi, et al stated that Pythagorean puzzle media can improve the ability to understand mathematical concepts. Then, in other studies also stated that the Pythagorean puzzle media was effective, practical and valid in building students' understanding (Rifai & Prihatnani, 2020). From the research that has been described, the model and learning media can be applied to this research. One way to measure the success of these learning methods and media is by giving pretest and posttest questions where the answers to the two questions will be analyzed and concluded through testing the success hypothesis.

B. Methods

1. Literature Review

Regarding the discovery learning model, we conducted a research review with other studies related to the research being carried out. First, Siti Wulandari and her friends conducted a study in 2019 entitled "The Effectiveness of Problem Based Learning and Discovery Learning Models Assisted by Tangrams on Mathematical Problem Solving Ability of Junior High School Students" this study aims to determine the effect of learning models on problem solving skills with tangram assistance (Wulandari et al., 2019). The equation of this research with the author's research is about the effect of the application of the discovery learning model on problem-solving skills. While the difference between this research and the author's research is in the population and sample. Siti Wulandari's research was applied to seventh-grade junior high school students. While the researchers used a sample of VIII grade junior high school students. In addition, it is also different in the material applied.

Second, a journal by Padrul Jana and his friends in 2020 entitled "Discovery Learning Model to Improve Problem Solving Ability". The equation of this research with the author's research is to determine the effect of the discovery learning model on students' problem solving skills (Jana & Fahmawati, 2020). The difference between this research and the author's research is in the material applied. In addition, the study only used a learning model while the author's research was assisted by learning media, namely the pythagorean puzzle.

Third, a journal by Mas'ud Rifai and Erlina Prihatnani entitled "Development of Puzzle Media for Proving the Pythagorean Theorem" researchers discuss the development of puzzle learning media to instill the concept of the Pythagorean theorem to students. Students get flexibility in using the learning media. In addition, it makes it easier for teachers to make their own media by determining the pieces of the puzzle in the way of use that has been provided (Rifai & Prihatnani, 2020). The difference between this research and the author's research is applying puzzles in class VIII. While the difference between this research and the author's research is to improve mathematical problem-solving skills.

Fourth, a journal by Ester Simare-mare and her friends entitled "The Effectiveness of Using the Discovery Learning Model on Students' Mathematical Problem Solving Ability at SMP Negeri 5 Padangsidimpuan" (Simare-Mare et al., 2020). The study has similarities in the dependent variable, namely mathematical solution ability. In addition, the independent variable

is the Discovery Learning learning model. In the author's research, the author added Pythagorean Puzzle media to the independent variable so that this made the author's research different from the research of Ester and her friends.

2. Experimental Design

This research is a quantitative method with an experimental design. This research is used to determine the effect of independent variables (treatment) on the dependent variable (outcome) under controlled conditions. Based on the type of experimental design, this research uses the Nonequivalent Control Group Design which is applied to the Pretest-Posttest Control Group Design. The table can be seen in Figure 3.1. In this design, there are two classes selected from pretest results with the same problem-solving ability. Then, it is divided into a control class and an experimental class to find out whether the post-test results are different between the two classes.

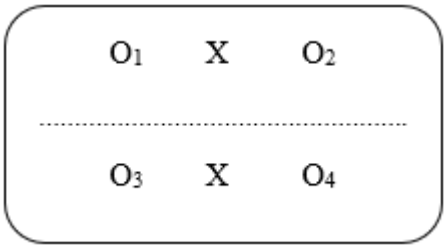

Figure 1. Format of Nonequivalent Control Group Design

The treatment given is marked with the symbol X, the pre-test is identified with the symbols O1 and O2, while the post-test is identified with the symbols O3 and O4. In addition, to complete this research, we conducted several stages as shown in the following Figure 2.

Figure 2. Research Method

In Figure 2 we can see several stages that are carried out, the first is data selection where the stage aims to collect data and select which data will be used. Then the next stage is data collection techniques where the stage has the aim of how to collect the data to be studied. The last step is data analysis techniques which is the stage for analyzing data in reaching a hypothesis. These stages will be explained in detail in the next chapter.

3. Data Selection

a. Population

Population is the whole object that will / wants to be studied (Sinaga, 2014). This population is often referred to as the universe. The following is a table of data on the number of students in each class.

Table 1. Total Number of Students

Class	Total Number of Students
VIII A	32
VIII B	32

VIII C	22
VIII D	22
VIII E	28
VIII F	27

Members of the data population are living and inanimate objects, and humans, where the properties that exist in them can be measured or observed. The population in this study were all students in class VIII MTs Muhammadiyah 01 Purbalingga.

b. Sampling

The sample is part of the number and characteristics of the population (Mokoagow et al., 2018). The sampling technique that will be used in the research is called the sampling technique. Sampling techniques are grouped into two types, namely: probability sampling and non-probability sampling, simple random, proportionate stratified random, disproportionate stratified random, and area random including probability sampling. While non-probability sampling includes systematic sampling, quota sampling, incidental sampling, purposive sampling, saturated sampling, and snowball sampling.

The sampling technique used in this research is purposive sampling technique (sample purpose). This technique is a sample with certain considerations (Sugiyono, 2009). The reason for using purposive sampling technique because Pythagoras material is included in class VIII material. Thus, the samples of this study were students of class VIII C and VIII D based on the recommendation of the mathematics teacher of class VIII MTs Muhammadiyah 01 Purbalingga.

The sampling technique used in this research is purposive sampling technique (sample purpose). This technique is a sample with certain considerations (Sugiyono, 2009). The reason for using purposive sampling technique because Pythagoras material is included in class VIII material. Thus, the samples of this study were students of class VIII C and VIII D based on the recommendation of the mathematics teacher of class VIII MTs Muhammadiyah 01 Purbalingga.

4. Data Collection Techniques

In this study we used the observation method. Observation is an activity of strengthening attention to objects using all senses (Hasanah, 2016). In this study, the researcher became the object of observation by teachers and friends. Researchers compile observation guidelines that contain a list of types of activities that may arise and will be observed. In the observation process, the observer only marks the column where the event appears. This observation was carried out in only a few meetings. All events that appear are checked; events that appear more than once in one observation cycle are only checked once. Thus, a picture of the events that appear in the teaching situation will be obtained.

This observation uses an observation sheet that contains statements in accordance with the lesson plan. The observation sheet in this study was used to determine the process of implementing discovery learning assisted by Pythagorean Puzzle in mathematics learning. Each stage is given a score according to the score guidelines given. Tests are a way of collecting data that presents a number of questions or instructions to research subjects where student responses can be categorized into correct responses or incorrect responses (Mashuri, 2016).

Tests are questions given to students to obtain answers from students in oral form (oral test), writing (writing test), or action form (action test). In this study, pre-test and post-test will be conducted. Pre-test will be done before treatment to students. Pre-test is done with the aim that researchers can find out the initial ability before treatment. While the post-test is done after the treatment carried out by researchers to students.

5. Data Analysis Techniques

After all the data is collected, then the data is analyzed to provide a hypothesis whether the model under study has met the expected hypothesis or not. There are two stages that are done, namely the prerequisite test analysis and hypothesis testing. The analysis prerequisite test includes a normality test and homogeneity test, while the hypothesis test includes T-test.

a. The Analysis Prerequisite

The data analysis prerequisite test aims to determine whether the data can continue hypothesis testing or not.

1. Normality Test

Normality testing is carried out to determine whether a data distribution is normal. This is important to know because it is related to the accuracy in choosing the statistical test to be used. Parametric statistical tests require data to be normally distributed. If the data is not normally distributed, it is recommended to test nonparametric statistics. Data normality testing can be done with Liliefors, Kolmogorov-Smirnov, and Chi-Square tests. In this study, we will use the Kolmogorov-Smirnov technique and SPSS 25. The test criteria for this technique are that the data is normally distributed if the Sig. ≥ 0.05 with a significance level of 5%. If the score Sig. < 0.05 then the data is not normally distributed (Nuryadi,. Astuti, T.D., Utami, E.S., & Budiantara, 2007).

2. Homogeneity Test

The homogeneity test was conducted to test the similarity of variants of each data group. Homogeneity test requirements are needed for inferential analysis on the comparison test. For testing the uniformity of variance of two normally distributed populations. The decision-making criteria for homogeneity testing through SPSS using the 5% significance level reference are as follows (Mariana & Zubaidah, 2015): If the sig. ≥ 0.05 then the two groups of data are declared homogeneous and if the sig. < 0.05 then the two groups of data are declared inhomogeneous.

b. Hypothesis Test

This study will use a t-test with independent samples. It is said to be independent because the data of two groups of one does not depend on the data of the second group. The test is checked based on the hypothesis (Rahmawati & Illiyin, 2021):

$$H_0 : \mu_1 = \mu_2$$
$$H_1 : \mu_1 \neq \mu_2$$

The statistics used are:

$$t_{result} = \frac{\bar{X}_D}{\sqrt{\frac{\sum d^2}{N(N-1)}}} \quad \ldots (1)$$

with

$\bar{X}_D$: The average of the subtraction of the first data and the second data

d : $D - \bar{X}_D$

N : The amount of data

The decision-making criteria are H0 rejected if $t_{result} < t_{table}$ and H0 accepted if otherwise, namely $t_{result} \geq t_{table}$. This research was assisted using SPSS 25.

C. Results and Discussion

1. Experimental Design

In this study, the experimental class, namely class VIII C, was treated with the discovery learning model assisted by the Pythagorean Puzzle with 22 students, and the control class, namely class VIII D, was not treated with the Discovery Learning model assisted by the Pythagorean Puzzle with 22 students. The implementation of the discovery learning model assisted by the Pythagorean Puzzle was measured by observation. In this study, there were two observers during the learning process. The observation was carried out for 4 consecutive meetings. The observation aimed to measure how well the researchers implemented the discovery learning model assisted by Pythagorean puzzle. The following Table 4.1 results of observation scores:

Table 2. Observation Score Result

Meeting	Observer 1	Observer 2	Average
1	4.09	4.36	4.23
2	4.18	4.63	4.40
3	4.18	4.36	4.27
4	4.18	4.27	4.23
Average	4.16	4.40	4.28

The data score of the observation of the implementation of discovery learning with the help of the Pythagorean puzzle there were 11 learning processes that must be carried out by researchers with the ideal score given a maximum of 5 and a minimum of 1. The average score obtained by researchers during 4 meetings with two observers was 4.28. It can be seen in Table 2 that the process of implementing discovery learning with the help of Pythagorean puzzles has been carried out very well.

2. Data Collection and Analysis

Data on students' initial mathematical solving abilities were obtained from pre-test data consisting of 2 problem-solving items which were then applied to class VIII C (as the experimental class) and class VIII D (as the control class). To find out the initial ability of students, the control class pre-test answer score in Table 3 to 4.

Table 3. Control Class Pre-test Answer Score

No	Student Name	Result
1	A. N. S.	20.00
2	A. R. N. A.	34.29
3	A. D. Y.	31.43
4	D. T.	25.71

5	F. A.	31.43
6	G. D. P.	28.57
7	H. S. N.	8.57
8	J. D. N.	20.00
9	K. A. D.	8.57
10	K. H. B.	17.14
11	M. G. F.	22.86

Table 4. Control Class Pre-test Answer Score (Continue)

No	Student Name	Result
12	M. H.	11.43
13	M. I. Z.	20.00
14	N. Z. N.	22.86
15	N. S. N.	14.29
16	N. D. A.	22.86
17	P. F.	8.57
18	P. D. P.	34.29
19	P. W. A.	28.57
20	R. S.	34.29
21	R	14.29
22	R. P. O.	14.29
	Average	

In addition, we can also see the pre-test results of the experimental class in Table 5. Between the control class and the experimental class have the same data, which is 22 data.

Table 5. Experimental Class Pre-test Answer Score

No	Student Name	Result
1	A	8.57
2	A. D. O.	14.29
3	B. S. S.	20.00
4	B	8.57
5	D. A. P.	28.57
6	F. S.	28.57
7	G. L. A.	17.14
8	I. R.	28.57
9	I. S. B.	34.29
10	J. P.	20.00
11	K. C.	8.57
12	K. A. N.	17.14
13	L. F.	20.00
14	N. N. D. A.	22.86
15	N. M.	22.86
16	R. H.	22.86
17	R	25.71
18	S. D.	34.29
19	S. S. J.	31.43
20	S. P.	11.43
21	Y. A. A.	14.29
22	Y. A. S.	34.29
	Average	

After knowing the initial ability of the control class and experimental class, then the implementation of discovery learning assisted by the Pythagorean puzzle was carried out. To measure how effective discovery learning aided by the Pythagorean puzzle is in improving students' mathematical solution skills, a post-test of 5 learning meetings was carried out. The following is a table of post-test scores of control class in Table 6.

Table 6. Control Class Post-test Answer Score

No	Student Name	Result
1	A.N.S.	25.79
2	A.R.N.A.	33.33
3	A.D.Y.	33.33
4	D.T.	28.57
5	F.A.	41.67
6	G.D.	33.33
7	H.S.N.	25.00
10	K.A.D.	16.67
11	M.G.F.	8.33
12	M.H.	16.67
13	M.I.Z.	58.33
14	N.Z.	41.67
15	N.S.N.	41.67
16	N.D.	33.33
17	P.F.	16.67
18	P.D.P.	58.33
19	P.W.A.	33.33
20	R.S.	33.33
21	R.	16.67
22	R.P.	25.00
	Average	

In addition, we can also see the post-test results of the experimental class in Table 7. Between the control class and the experimental class have the same data, which is 22 data.

Table 7. Experimental Class Post-test Answer Score

No	Student Name	Result
1	A	73.53
2	A. D. O.	85.29
3	B. S. S.	70.59
4	B	79.41
5	D. A. P.	67.65
6	F. S.	52.94
7	G. L. A.	82.35
8	I. R.	67.65
9	I. S. B.	52.94
10	J. P.	52.94
11	K. C.	52.94
12	K. A. N.	55.88
13	L. F.	76.47
14	N. N. D. A.	58.82
15	N. M.	64.71
16	R. H.	52.94

17	R	85.29
18	S. D.	52.94
19	S. S. J.	85.29
20	S. P.	52.94
21	Y. A. A.	67.65
22	Y. A. S.	61.76
	Average	

We can see from Table 3 to Table 7 that there are differences from each test given. The pre-test and post-test data will be tested for comparison as follows.

a. Pre-test Comparison Test

1. Normality Test

The normality test aims to determine whether the data taken from the population is normal or not. In this study using the Kolmogorov-Smirnov test assisted by SPSS 25 with the following output:

Table 8. Normality Test Results of Pre-test Data

One-Sample Kolmogorov-Smirnov Test		
		Pre-test Score
N = 44		
Normal Parameters	Mean	21.5593
	Std. Dev.	8.50445
Most Extreme Differences	Absolute	.113
	Positive	.099
	Negative	-.113
Test Statistic		-.113
Asymp. Sig. (2-tailed)		.189

In Table 8 there is information on the results of the calculation of the normality test on the pre-test scores. In this study, we used Asymp. Sig. 2-tailed to determine whether the data is normal or not. Based on the table of normality test results, the Sig value. 0.189. Because the significance value ≥ 0.05, it can be concluded that the data is normally distributed.

2. Homogeneity Test

The homogeneity test is used to ensure that the pre-test score data of the experimental class and control class are homogeneous. In this study, the Levene Test with the help of SPSS 25. The results of the homogeneity test output are as follows:

Table 9. Homogeneity Test Results of Pre-test Data

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Pre-test Score	Based on Mean	.973	1	42	.850
	Based on Median	.845	1	42	.850
	Based on Median and with adjusted df	.845	1	42.000	.850
	Based on trimmed mean	.987	1	42	.850

Based on the Table 9, the significance value is 0.850. Because the significance value of 0.850 ≥ 0.05, it can be concluded that the data is homogeneous.

3. T Test

In the T test we have two hypotheses

H0 : μ1= μ2

H1 : μ1≠μ2

with μ1 expressed the mathematical problem-solving ability of the experimental class and μ2 stated the mathematical problem-solving ability of the control class. The t-test output results are as follows:

Table 10. T Test Results of Pre-test Data

Independent Samples Test									
Mean of Pre-test Data = 20.71		t-test for Equality of Means							
		Mean Difference	Std. Error Difference	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pre-test Score	Equal variances assumsed	.00045	2.59453	1.834455	-5.23553	5.23644	.000	42	1.000

Based on the Table 10, the significance value is 1.000. Because the significance value ≥ 0.05, then H0 is accepted which means that the initial ability of the experimental class is the same as the mathematical problem-solving ability of the control class.

b. Post-Test Comparison Test

1. Normality Test

The normality test aims to determine whether the data taken from the population is normal or not. In this study using the Kolmogorov-Smirnov test assisted by SPSS 25 with the following output:

Table 8. Normality Test Results of Post-test Data

One-Sample Kolmogorov-Smirnov Test		
		Post-test Score
N = 44		
Normal Parameters	Mean	48.1950
	Std. Dev.	22.69531
Most Extreme Differences	Absolute	.128
	Positive	.104
	Negative	-.128
Test Statistic		-.128
Asymp. Sig. (2-tailed)		.067

From the Table 12, the results of the calculation of the normality test on the post-test scores. In this study, we used Asymp. Sig. 2-tailed to determine whether the data is normal or not. Based on the table of normality test results, the Sig value. 0.067. Because the significance value ≥ 0.05, it can be concluded that the data is normally distributed.

2. Homogeneity Test

The homogeneity test is used to ensure that the post-test score data of the experimental class and control class are homogeneous. In this study, the Levene test with the help of SPSS 25. The results of the homogeneity test output are as follows:

Table 12. Homogeneity Test Results of Post-test Data

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Post-test Score	Based on Mean	3.577	1	42	.065
	Based on Median	2.120	1	42	.153
	Based on Median and with adjusted df	2.120	1	38.798	.153
	Based on trimmed mean	3.552	1	42	.066

Based on the Table 12, the significance value is 0.065. Because the significance value of 0.065 ≥ 0.05, it can be concluded that the data is homogeneous.

3. T Test

In the T test we have two hypotheses

H0 : μ1=μ2

H1 : μ1≠μ2

with μ1 expressed the mathematical problem-solving ability of the experimental class and μ2 stated the mathematical problem-solving ability of the control class. The t-test output results are as follows:

Table 13. T Test Results of Post-test Data

Independent Samples Test									
Mean of Post-test Data = 20.71		t-test for Equality of Means							
		Mean Difference	Std. Error Difference	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Post-test Score	Equal variances assumsed	-35.69364	4.19594	2.946805	-44.16138	-27.22589	-8.507	42	.000

Based on Table 13, the significance value is 0.000. Because the significance value < 0.05, then H0 is rejected, H1 is accepted, which means that the mathematical problem-solving ability of the experimental class is different from the mathematical problem-solving ability of the control class after different treatments are applied. It can be said that there is an increase in students' problem-solving ability in the experimental class.

3. Discussion

This sub-section will explain the results of the research that has been carried out by researchers. This series of studies began in December, starting with preliminary observations then testing the validity of research instruments. Researchers took two classes as samples for research, namely class VIII C as an experimental class with 22 students and class VIII D as a control class with 22 students. Then the two classes were given pretest questions to ensure that the two classes had the same mathematical problem-solving skills.

The control class applied conventional learning without the help of learning media to support learning activities. The experimental class implemented discovery learning with the help of the Pythagorean puzzle. The following is a picture of this research activity.

Figure 3. Research Activity

In Figure 3, we can see that students are very enthusiastic in math learning. This research was conducted for 4 meetings in each class group, with learning material namely the Pythagorean theorem. The implementation of discovery learning aided by the Pythagorean puzzle starts from January 7, 2023, to January 21, 2023, in accordance with the attached schedule and lesson plan.

During the process of implementing discovery learning with the help of Pythagorean puzzles, there were two observers as observers and assessors. This aims as evidence that researchers have carried out learning steps in accordance with the learning model used. The results of each observer's assessment can be seen in Table 2 based on this table, shows that the average score of the assessment by the first observer for 4 meetings was 4.16. While the average score of the assessment by the second observer for 4 meetings was 4.40. So, the average score of the implementation of discovery learning assisted by the Pythagorean puzzle is 4.28.

After the process of implementing discovery learning aided by the Pythagorean puzzle was carried out, the researcher gave posttest questions to the control class and experimental class. The results of the pretest and posttest were then tested for comparison through the prerequisite analysis test, namely the normality test and homogeneity test. Then continue to test the hypothesis using the t-test.

In the pre-test comparison test, the normality test results showed that the Sig. 0.189. Because the significance value ≥ 0.05, it can be concluded that the data is normally distributed. After knowing that the data is normally distributed, then homogeneity is tested. It is known that the significance value is 0.850. Because the significance value ≥ 0.05, it can be concluded

that the data is homogeneous. Then continue to test the hypothesis using the t test. Based on the t test results table, the significance value is 1.000. Because the significance value ≥ 0.05, then H0 is accepted which means that the mathematical problem-solving ability of the experimental class is the same as the mathematical problem-solving ability of the control class before different treatments are given to the control class and the experimental class.

In the posttest comparison test, the normality test results show the Sig value. 0.067. Because the significance value ≥ 0.05, it can be concluded that the data is normally distributed. After knowing that the data is normally distributed, then homogeneity is tested. It is known that the significance value is 0.065. Because the significance value ≥ 0.05, it can be concluded that the data is homogeneous. Then continue to test the hypothesis using the t test. Based on the t test results table, the significance value is 0.000. Because the significance value < 0.05, then H0 is rejected. So H1 is accepted, which means that the mathematical problem-solving ability of the experimental class is different from the mathematical problem-solving ability of the control class after different treatments are applied in the two classes. This can also be seen from the average value of the experimental class which is 66.04 while the control class is 30.35.

There is a difference in the mathematical problem-solving ability of the experimental class and the control class after different treatments. The average mathematical problem-solving ability of the experimental class is higher than the mathematical problem-solving ability of the control class. So, we can know that there is an increase in mathematical problem-solving ability in the experimental class.

In this study, the implementation of discovery learning aided by the Pythagorean puzzle was effective in improving the mathematical problem-solving skills of class VIII students of MTs Muhammadiyah 01 Purbalingga. This is supported by the research of Ester Simare-mare, et al with the title "The Effectiveness of Using the Discovery Learning Model on Students' Mathematical Problem Solving Ability at SMP Negeri 5 Padangsidimpuan" (Simare-Mare et al., 2020). The results showed that the average pre-test score was 63.33 in the sufficient category and the average posttest score was 83.67 in the very good category. So that the use of the discovery learning model is significantly effective on the mathematical problem-solving ability of class VIII students of SMP Negeri 5 Padangsimpuan.

In another study conducted by Padrul and Amirul explained that the learning model must be adjusted to the situation and conditions in the classroom and consider the material to be taught, such as the discovery learning model has a positive impact on students' skills in solving mathematical problems (Jana & Fahmawati, 2020). In addition, Siti Wulandari and friends also said in a study entitled "The Effectiveness of Problem-Based Learning and Discovery Learning Models Aided by Tanggram on Mathematics Problem Solving Skills of Junior High School Students" that Discovery Learning is effective on problem-solving skills due to the active students seeking new knowledge, easier understanding of the material provided, the ability of students to socialize between group members so as to improve the ability to solve the problems given (Gusmania & Marlita, 2016).

This statement is also supported by Borthick and Jones who say that Discovery Learning is also closely related to problem solving (or learning how to solve problems under a more metacognitive perspective) (Borthick & Jones, 2000). The results of another study by Mas'ud Rifai and Erlina Prihatnani showed that the Pythagorean puzzle was used to instill a concept understanding of the Pythagorean theorem. Pythagorean puzzles are effectively used to

construct students in learning Pythagoras (Rifai & Prihatnani, 2020). Understanding students' mathematical concepts greatly affects students' problem-solving ability. Research conducted by Damianus Siki, Kristofous D. Djong and Yohanes O. Jagom said that subjects with high and medium problem solving abilities had no difficulty in understanding mathematical concepts (Jagom et al., 2021). This statement is also supported by Indah Suciati, Rio Fabrika Pasandaran and Hajerina who said that the higher the students' mathematical concept understanding ability, the better the students' mathematical problem solving ability (Suciati et al., 2021).

D. Conclusion

Discovery learning with the help of pythagorean puzzles in mathematics learning was implemented, especially the Pythagorean theorem material in class VIII MTs Muhammadiyah 01 Purbalingga very well. This is evidenced by the results of observations by two observers for 4 meetings with an average score of 4.28 which means they have done very well. The implementation of discovery learning assisted by pythagorean puzzle effectively improves the mathematical problem-solving ability of students in class VIII MTs Muhammadiyah 01 Purbalingga. This can be seen from the results of the post-test comparison test which obtained a sig (2-tailled) of 0.000 <0.05, which means that there is a difference in the average of the experimental and control classes.

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Effectiveness of Realistic Mathematics Approach To Increasing Mathematical Representation Ability at SMP N 9 Purwokerto

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Abstract: This research was conducted based on the low ability of students' mathematical representation in the eighth-grade students of SMP N 9 Purwokerto. One of the contributing factors was that the use of the learning approach had not facilitated students in developing mathematical representation abilities. The solution that was considered capable of improving the ability of mathematical representation was to apply the learning process with a realistic mathematical approach. The realistic mathematics approach provided opportunities for students to do modeling, depicting, and symbolizing related to concrete problems. This research was quantitative with a quasi-experimental type with Nonequivalent Control Group Design. The population in this study were all students of grade eight of SMP N 9 Purwokerto. The sample in this study was the students of VIII A with a total of 36 students and VIII B with a total of 36 students. The data analysis used was the z-test and the N-Gain test. The results of the z-test showed a significant effect, the mathematical representation abilities of the experimental class students were higher. Then, the results of the N-Gain test showed that the experimental class was in the medium category and the control class was in the low category. Thus, the representation ability of the experimental class students was higher than that of the control class. The results of this study indicate that the realistic mathematical approach is effective in increasing students' mathematical representation abilities.

Keywords: Mathematical Representation; Realistic Mathematics; Research Results.

A. Introduction

Mathematical representation skills are skills that must be developed and mastered in learning mathematics. According to the National Council of Teachers of Mathematics (NCTM) representation is a skill in translating or transferring a mathematical problem to another form or configuration, the other form can be images or modeling in the form of symbols, graphs, diagrams, tables, orals, and sentences. NCTM recommends that learning programs for students in grades pre-kindergarten through 12 require them to be able to: (1) Create and use representations to plan, record, and communicate mathematical ideas; (2) Selecting, applying, and translating mathematical representations to solve problems; and (3) Using representations in modeling based on phenomena that occur in the student's environment (NCTM, 2000).

Then it was emphasized again in Permendikbud number 58 of 2014 which regulates subject matter standards starting from elementary school to high school, explaining that students' mathematical representation ability is an ability that must be mastered in learning

mathematics. Representational ability here is an activity of processing, displaying, and reasoning in concrete domains such as using, modifying, translating, transforming, modeling, and creating and reasoning in abstract realms such as writing, speaking, calculating, and composing in accordance with learning standards in schools and other sources.

The facts from the direct observation that are happening now show that most teachers pay little attention to students' mathematical representation abilities as an important basis in learning mathematics. Students' skills in performing mathematical representations such as making tables, graphs, images and symbols are not given much attention to their development in the classroom environment, many teachers still view these abilities as accessories in learning. Learning activities by focusing on the teacher as a learning resource cause students not to be free to express their own representational abilities. As a result, students are more likely to follow teacher instructions and hinder the development of students' representation abilities.

The ability to create models and develop mathematical models is an important component of mathematical representation abilities, but in Indonesia students' abilities in this field are still lacking. On a global scale, reports on the achievements of Indonesian students, especially the results from the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA), are proof of this. Indonesia is ranked 44 out of 49 countries in the ranking by TIMSS. then, Indonesia ranks 74th out of 79 countries in the 2018 PISA results. This data can be used as evidence that students' ability to create models and develop mathematical modeling is still low and needs special attention (Tohir, 2019).

The use of a Realistic Mathematical Approach is thought to be an alternative that can improve students' mathematical representation abilities. The use of students' mathematical representations can be explored through realistic mathematics approach learning. Model-based learning is a feature of realistic mathematics approach, which means that a mathematical concept or problem can be represented as a model. The model in question can be obtained by a concrete situation or a model that develops to an abstract level (Al jupri, 2012). In the learning process using realistic mathematics approach will pay attention to and explore the potential of students who must be discovered and developed. The teacher's belief in the existence of potential in students will create how teachers plan the process of learning mathematics which aims to discover and develop students' abilities. This condition will affect both the teacher's teaching habits and student learning habits. In this lesson students are expected to be able to communicate their point of view and respect the viewpoints of others. A teacher needs to reduce his tendency to teach and switch functions to become a facilitator in learning activities (Soedjadi, 2007)

The application of realistic mathematics approach is carried out by integrating it with practical context and experience. Therefore, the application of realistic mathematics approach facilitates students' mathematics learning and improves the ability of mathematical representation according to students' abilities. This method can encourage students to discuss, work together, exchange ideas with other students and be able to find their own concepts. The realistic mathematics approach learning concept used is real-world situations and student experiences so that it becomes a good initial foundation for developing students' mathematical representation abilities (holisin, 2007). Like the research conducted by Misel and Erna

Suwangsih, students' mathematical representation skills can be improved by applying a realistic mathematical approach. This type of research is class action research (classroom action research). In this study, the change in mathematical representation ability from cycle 1 to cycle 2 after being given a realistic mathematical approach treatment has a very high category (Misel and erna, 2018).

The pioneer of realistic mathematics education, Hans Freudenthal, argues that students cannot be viewed as passive consumers of ready-made mathematics, on the contrary, mathematics education must encourage students to use various contexts and opportunities to retrieve mathematics in creative ways themselves (Hadi, 2018). The realistic mathematics approach learning concept used is real-world situations and student experiences so that it becomes a good initial foundation in starting to learn mathematics.

In interviews with mathematics teachers at SMP N 9 Purwokerto the ability of students' mathematical representations is not maximized and has not been fully implemented in the learning process, this condition can be proven from the ability of students to solve real or contextual problems, where there are still many students who are less skilled in constructing their logic into the form mathematical representation, this is influenced by several factors, the first is due to a lack of understanding of mathematical concepts, students have a less in-depth understanding of basic mathematical concepts, such as numbers, mathematical operations, geometry, and algebra. This can affect their ability to represent mathematical problems visually or symbolically. Second, Lack of mathematical modeling skills, mathematical representation involves the ability to transform real-world problems into a mathematical form that can be understood and solved. Students may have difficulty identifying variables, constructing equations or functions, or using mathematical notation correctly to model mathematical situations. Third, students' limitations in visualizing mathematical problems in the form of pictures or diagrams become mathematical understanding, this can affect the ability of graphical representations or diagrams in solving mathematical problems.

This problem is caused by students not accustomed to dealing with contextual problems that are contained in other representations in mathematical models. Mathematical representational ability is one of the competencies that must be achieved in learning mathematics, but students at SMP N 9 Purwokerto have not got this to the fullest, one way that is thought to be able to improve students' mathematical representation abilities is to use a realistic mathematics approach. Based on this problem the aim of the research this is to determine the effectiveness of a realistic mathematical approach to improving students' mathematical representation abilities at SMP N 9 Purwokerto.

B. Methods

The type of research used is a type of experimental research using a quantitative approach. Experimental research is a research technique used in order to find out how far the influence of a certain treatment on something else in a controlled situation. The quantitative approach is research conducted based on data analysis using statistical procedures (Sugiyono, 2016). This study used a quasi-experimental type of research with the Nonequivalent Control Group Design category, because the researcher wanted to know the effectiveness of the realistic mathematical approach on students' representation abilities before being given treatment and after being given treatment. In this study, the independent variable is "Realistic

Mathematical Approach" and the dependent variable is "Students' Mathematical Representational Ability".

This research was conducted at SMP N 9 Purwokerto in January 2023, the object of the research was class VIII students at SMP N 9 Purwokerto who were going through semester II. The population used was students from class VIII A to class VIII H, totaling 288 students. Then the samples used as the research were class VIII G and class VIII H, who were randomly selected. Class VIII G has 36 students as the control class and class VIII H has 36 students as the experimental class.

The research procedure begins with giving a pretest to the experimental class and the control class. The researcher wanted to know the extent to which students' mathematical representation abilities were given before being given treatment using a realistic mathematical approach. After that, by providing treatment for several learning sessions or meetings, where the experimental class learning uses a realistic mathematical approach and the control class uses a conventional approach. then the posttest was given in the last meeting in the experimental class and control class to ensure changes in students' mathematical representation abilities after being given treatment. The research was carried out in a planned manner according to the running schedule at SMP N 9 Purwokerto.

The data collection technique used is as follows interview, this interview method takes information from a grade VIII mathematics teacher at SMP N 9 Purwokerto as the most relevant source. Then The observation technique applied in this study was to determine the condition of the object directly such as the geographical location of the school, the completeness of school facilities and infrastructure and the teaching and learning process at SMP N 9 Purwokerto. Documentation, documentation is a technique of collecting data from various sources that are relevant to the object of research, the data collected can be in the form of pictures, notes, documents, transcripts, books and other sources (Hamzah and susanti, 2016). Test, the test is an instrument or tool consisting of several questions or questionnaires that are used to measure the knowledge, skills and talents of the subject under study. The instrument sheet is a type of test in the form of questions or questions. The object under study will be measured using questions that have been set according to the variables determined by the level (Amir and Lidia, 2020). In this study, tests in the form of pretest and posttest were carried out in the control group (Class VIII G) and the experimental group (Class VIII H). The test used to obtain an overview of students' representational abilities is in the form of realistic math problem solving test scores.

Before the research was carried out, the test instrument was tested for data quality first, namely through a validity test. Validity test is used to measure the extent to which the function of a test instrument is said to be valid or not to be tested. (Amir and Lidia, 2016). In this study, the validity test used the expert validity test and the validity test used the product moment correlation coefficient.

Table 1. Test the validity of the instrument test

	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
r_hitung	0.710	0.782	0.806	0.518	0.615	0.635	0.709	0.766	0.542	0.624
r_tabel	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329
V/IV	V	V	V	V	V	V	V	V	V	V

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10

V : Valid
IV : Invalid

From the table above using r_table at a significance of 5% (0.05) with a total of 36 respondent data so that r_table shows a value of 0.329. A test instrument is said to be valid if the value of r_count ≥ r_table, using the excel application of the 10 questions all test instruments show valid results because r_count ≥ r_table.

After the test instrument is valid then it is continued with the reliability test. The reliability level is said to be sufficient when the Cronbach Alpha value is ≥ 0.7, if the Cronbach Alpha value is ≥ 0.8 then all test instrument items are said to have strong reliability (Amir and Lidia, 2016). In this test the Cronbach Alpha value of 0.796990 is included in the sufficient reliability category because ≥ 0.7 Cronbach Alpha value. Of the 10 questions that were valid and reliable, the researcher took 5 questions that were used as test instruments. After the test instrument is valid and reliable then proceed with the normality test, homogeneity test, z-test and N-Gain score test.

C. Results and Discussion

This research was conducted with the aim of knowing the effectiveness of a realistic mathematical approach to the mathematical representation abilities of students at SMP N 9 Purwokerto. This representation ability was measured by the types of questions on the Pythagorean theorem material. This research was conducted in class VIII, two classes that became the object of research, namely class VIII G as the control class and class VIII H as the experimental class.

In practice, the experimental class and the control class were given different treatments, the experimental class was given treatment in the form of learning using a realistic mathematical approach and the control class was given learning in a conventional way. The purpose of having different treatments is to determine the effect of a realistic mathematical approach on students' representation abilities. The following are the results of the pretest and posttest data analysis from the experimental class and the control class.

1. The Results Of Data Analysis Pretest Experiment Class And Control Class

The pretest was carried out before the experimental class and control class were given treatment, namely the experimental class used a realistic mathematical approach and the control class used a conventional approach. The purpose of the pretest was to determine the initial condition of students' representation abilities.

Then the results of the pretest are tested whether the data is normally distributed. In this study, the normality test used the Shapiro Wilk method, when the p-value ≥ 0.05, the data is normally distributed, and if the p-value < 0.05, the data is not normally distributed (Rozali, 2011). The following are the results of the pretest Normality Test for the experimental class and the control class using the python application.

	Class	Statistic	p-value
0	Eksperiment_Pretest	0.948880	0.096422
1	Control_Pretest	0.952957	0.129572

Figure 1. Pretest Normality Test for Experimental Class and Control Class

From the results of Figure 1, the pretest value for the experimental class has a p-value = 0.096 and the pretest value for the control class has a p-value = 0.129. All of these tests show a p-value ≥ 0.05 so that the data is normally distributed.

After all the data is normal, the data is continued with a homogeneity test, the aim is to find out whether the samples are in the same population. The homogeneity test used is the Levene test, if the p-value is ≥ 0.05 then the data is said to be homogeneous and if the p-value < 0.05 then the data is not homogeneous (Yulingga and Wasis, 2017). The following are the results of the homogeneity test of the posttest experimental and control class data using the Python application.

```
stats.levene(Pretest_Eksperiment,Pretest_Control)

LeveneResult(statistic=0.0, pvalue=1.0)
```

Figure 2. Homogeneity Test Pretest Experiment Class and Control Class

Based on the iteration results in Figure 2, we can conclude that the pretest values for the experimental and control classes have a p-value of 1,000 > 0.05, so the data can be said to be homogeneous. To find out the initial conditions whether there is a significant difference between the experimental class and the control class before being given treatment, the data is carried out a hypothesis test. In this study using the z-test because the data is more than 30 samples. The criterion in the z-test is when the z-score value ≥ z-table then Ho is rejected and Ha is accepted, then if the z-score < z-table then Ho is accepted and Ha is rejected (Takiar, 2021). The following are the results of the pretest z-test of the experimental class and the control class using the Python application.

```
Z Score Pretest_Eksperiment_Control: 0.5995770664853974
Z value table on alpha = 0.05 : 1.6448536269514722
Z-score  < Z-table.
the data does not show a significant difference.
```

Figure 3. Z-Test Pretest Experiment Class and Control Class

The results of the iteration in Figure 3 show that the z-score = 0.599 and the z-table value = 1.644, so that the z-score <z-table, so that Ho is accepted and Ha is rejected, in other words the pretest value of the experimental class and control class (no treatment has been done) did not show a significant difference.

2. The Results of Data Analysis Posttest Experimental Class and Control Class

The posttest was carried out after the experimental class and control class were given treatment, namely the experimental class used a realistic mathematical approach and the control class used a conventional approach. The purpose of the posttest was to find out the development or changes in students' representation abilities after being given treatment.

Then the results of the posttest are tested whether the data is normally distributed. In this study, the normality test used the Shapiro Wilk method, when the p-value ≥ 0.05, the data is normally distributed and if the p-value < 0.05, the data is not normally distributed (Rozali,

2011). The following are the results of the Posttest Normality Test for the experimental class and the control class using the python application.

	Class	Statistic	p-value
0	Eksperiment_Posttest	0.941359	0.056002
1	Control_Posttest	0.953946	0.139179

Figure 4. Posttest normality test for experimental class and control class

From the results of Figure 4, the pretest value for the experimental class has a p-value = 0.056 and the pretest value for the control class has a p-value = 0.139. All of these tests show a p-value ≥ 0.05 so that the data is normally distributed.

After all the data is normal, the data is continued with a homogeneity test, the aim is to find out whether the samples are in the same population. The homogeneity test used is the Levene test, if the p-value is ≥ 0.05 then the data is said to be homogeneous and if the p-value < 0.05 then the data is not homogeneous (Yulingga and Wasis, 2017). The following are the results of the homogeneity test of the posttest experimental and control class data using the Python application.

```
stats.levene(Posttest_Eksperiment,Posttest_Control)
```

```
LeveneResult(statistic=0.4525182172017207, pvalue=0.5033561662553766)
```

Figure 5. Posttest Homogeneity Test of Experimental Class and Control Class

Based on the iteration results of Figure 5, the posttest values for the experimental and control classes have a p-value of 0.503 ≥ 0.05. Because the data is ≥ 0.05, the data is homogeneous. To find out the final condition whether there is a significant difference between the experimental class and the control class after being given treatment, the data is tested by a hypothesis. In this study using the z-test because the data is more than 30 samples. The criterion in the z-test is when the z-score value ≥ z-table then Ho is rejected and Ha is accepted, then if the z-score < z-table then Ho is accepted and Ha is rejected (Takiar, 2021). The following are the results of the posttest z-test of the experimental class and the control class using the Python application.

```
Z Score Posttest_Eksperiment_Control: 7.991543048365845
Z value table on alpha = 0.05 : 1.6448536269514722
Z-score >= Z-Table.
the data shows a significant difference.
```

From the iteration results in Figure 6, it shows that the z-score = 7,991 and the z-table value = 1,644, so that the z-score ≥ z-table, so that Ho is rejected and Ha is accepted, in other words, the posttest value of the experimental class and control class (after being given treatment) showed a significant difference. Then the following diagram illustrates the comparison of the values of the experimental and control classes after being given treatment

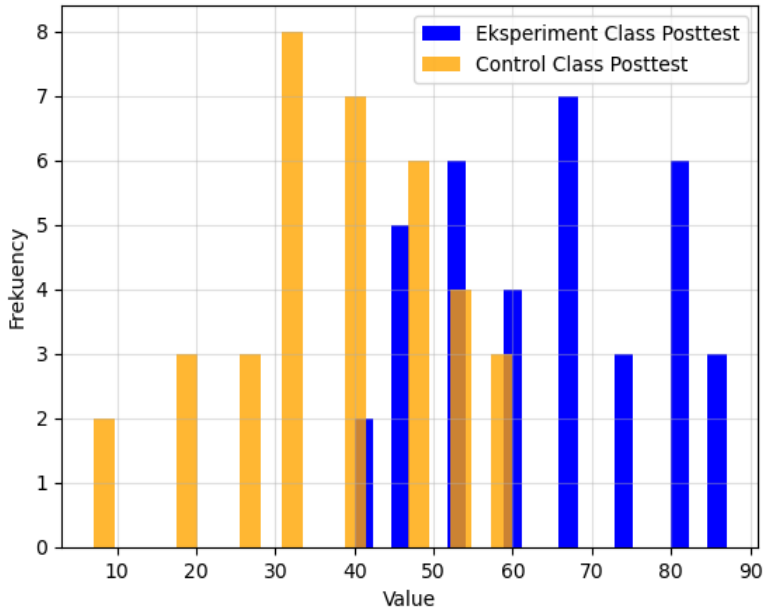

Figure 7. Posttest Histogram of Experimental Class and Control Class

The histogram data in the Figure 7 the posttest value of the experimental class shows a significant change in value from the posttest value of the control class. This can be seen in the histogram above which shows that the distribution of data in the experimental class posttest has a higher value. So we can say that the treatment using a realistic mathematical approach to the experimental class has a significant effect.

3. Uji N-Gain Score

Gain is the difference between the pretest and posttest scores. The increase in students' mathematical representation abilities in the two groups can be calculated using the normalized average gain formula. N-gain (normalized gain) is used to measure students' mathematical representation abilities before and after treatment (Sesmyanti, 2020). The following is the result of calculating the N-Gain score using the excel application.

No.	Class	N-Gain Score	Interpretation
1	Eksperiment	0.5276	Effective
2	Control	0.1816	ineffective

Table 2. N-Gain Score Results

Based on the table above, the results of the N-Gain test in the experimental class are 0.5276, this value is included in the medium criteria. While the control class has an N-Gain value of 0.1816 which is included in the low criteria. The results of the N-Gain show a positive difference, meaning that the experimental class after being treated in the form of a realistic mathematical approach has an increase in better representation results.

Then to find out whether the N-Gain results have an influence, the N-Gain results of the control class and the experiment are carried out by Z-Test. The following are the Z-Test results of the N-Gain values of the control class and the experimental class.

```
Z Score Pretest_Eksperiment_Control: 9.03186939909925
Z value table on alpha = 0.05 : 1.6448536269514722
Z-score >= Z-table.
the data shows a significant difference.
```

Figure 8. Z-test N-Gain Scores for Experimental and Control Classes

The results of the iteration Figure 8 show that the z-score = 9,031 and the z-table value = 1,644, so that the z-score ≥ z-table, so that Ho is rejected, in other words the posttest value of the experimental class and the control class (after being given treatment) shows a difference significant.

D. Conclusion

Based on the results of the research and discussion described in the previous chapter, it can be concluded that the use of a realistic mathematical approach is effective in improving students' mathematical representation skills in class VIII SMP N 9 Purwokerto. This can be seen in the results of data analysis carried out through the calculation of the Hypothesis Test (z-Test) and the N-Gain Test, Score. In the z-test, the posttest scores for the experimental and control classes have a z-score value = 7,991, and a z-table value = 1,644, which means that the z-score ≥ z-table, so that the Ho hypothesis is rejected and the Ha hypothesis is accepted, therefore the class posttest value the experimental and control class after being treated showed a significant difference, in other words that the experimental class which had been treated with a realistic mathematical approach could improve students' representation abilities. Then through the N-Gain Score Test the experimental class obtained an average N-Gain of 0.5276 included in the effective criteria. While the control class obtained an average N-Gain of 0.1816 included in the ineffective criteria. So it can be seen that the results of the N-Gain scores in the experimental class are higher than the N-Gain scores in the control class, therefore a realistic mathematical approach is effective in improving students' mathematical representation abilities.

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The Effect of Mind Mapping Methods Types of Mind Map Syllabus on Mathematics Problem Solving Ability In Flat Side Space Construction Materials of Class VIII Students of SMP Negeri 1 Karangreja District Purbalingga

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Abstract: This study aims to determine whether there is an influence of the mind mapping syllabus method on the mathematical problem-solving abilities of the eighth-grade students of SMP Negeri 1 Karangreja, Purbalingga. Mathematical problem-solving ability is a quality possessed by someone to solve mathematical problems so that the goals to be achieved are resolved properly. One of the factors that influence the ability to solve mathematical problems is the model or method used in learning. The researcher chose to use the mind mapping method, a type of mind map syllabus, to improve students' mathematical problem-solving abilities. This study used quantitative research (experimental research) with a Quasi-Experimental Design. The population of this study were all of the eighth-grade students which consisted of 5 classes. The samples of this study were the students of VIII A which consisted of 26 students, and VIII B which consisted of 22 students. The data collection technique in this study used a test consisting of a pretest and a posttest. The data analysis of this study applied the t-test and the N-Gain test using the SPSS version 25. The results of this study indicate that there is an influence of the syllabus-type mind mapping method on the math problem-solving abilities of the eighth-grade students of SMP Negeri 1 Karangreja, Purbalingga. The N-Gain results show that the N-Gain of the experimental class is included in the high category with an average N-Gain of 0.70 and the control class is included in the medium category with an average N-Gain of 0.54. So, the increase in students' mathematical problem-solving abilities in the experimental class is higher than in the control class.

Keywords: Mathematics; Mind Mapping ; Problem Solving.

A. Introduction

Solving problem is a business process participant educate in framework find solution on given problem or he faced with use all knowledge, skills, and understanding possessed (Archi, 2020 :20). According to Polya, solving problem is something business look for road go out from something purpose which is not so easy quick can achieved (Heris, 2021:44). Ability is quality from someone who can do something (Ahmad, 2020:26). In finish problem math, students should can use the abilities it has. Can concluded that, ability solving problem mathematics is owned quality somebody for find solution or solve problem mathematics so that desired goal achieved resolved with ok.

Ability solving problem important owned student for reach objective learning. Objective learning math 2013 according Ministry of Education and Culture is increase ability intellectual

specifically ability level tall students, form ability student in finish something problem in a manner systematically, obtain results high learning, training student in communicate particular ideas in write work scientific, and develop character students (Agustami, 2021: 224). Importance ability solving problem mathematics is also emphasized in The National Council of Teachers of Mathematics (NCTM) stated that solving or settlement problem should become center from learning mathematics, because settlement problem is part from all activity math and is objective main from all instructions mathematics (Ahmad, 2020:19). Solving problem role important in the learning process math.

Then in ability solving problem, there a number of necessary indicator noticed as stated by Polya, there is four a must indicator achieved that is understand problem, devising a strategy or plan settlement problem, solve problem with using the strategy that has been planned, and checked repeat answer (Ahmad, 2020:24). High low ability solving problem can influenced various thing, for one thing is application method or the strategy used in the learning process (Ningsih, 2023:24).

Every participant educate expected capable solve problem with apply his knowledge. In life every day, us faced with demanding problem ability solving problem. Whole material mathematics own level ability solving each other's problems. One of them that is material mathematics get up room side related flat with solving problem nor life every day. on matter this student difficulty for identify problem about elements get up room side flat, define and apply a mathematical model or formula used as solution for reach desired goal. Besides that, students difficulty in hook between one formula with another formula, in matter This is formula wide surface and volume wake room side flat.

Based on observation introduction at SMP Negeri 1 Karangreja Regency Purbalingga on October 25, 2023 with do interview to math teachers class VIII, namely Mrs. Lasiana, S.Pd. state that student obtain low value when given task For do question. It because student not yet fully understand material that has delivered. Most student no can estimate and apply formula used for finish problem. Student not enough capable do calculation in a manner regular or not corrected return answers that have made. Besides that, students not enough learn and easy forget with material that has delivered.

One method that can used is method mapping (mind mapping) types mind map syllabus. Mapping deep thoughts (mind mapping). The app is very helpful for understand problem with fast because already mapped and got used for optimizing function brain student so that make learning become effective (Dyah, 2018: 11). According to Tony Buzan, method mind map can help in a number of aspect like plan, concentrate attention, compose mind, explained mind, remember with fine, study more fast and efficient, as well can practice picture in a manner as a whole (Sri, 2022:43). There are several type mind mapping that can used, for one that is mind map syllabus. Mind map syllabus often called mind mapping macro that is mind mapping that describes concept on size big and got pasted on the wall so that will understand and get remembered (Lestari, 2020:15). With mapping, students will more easy for learn something draft material so that can help student in understand problem.

According to Pandley, step learning use mind mapping that is convey material and goals learning, students learn draft about the material being taught, grouping student to in a number of group, students make map thought from material learned, students present results map mind,

guide student make conclusion, give question exercises, and tests after learning for know understanding concepts and abilities academic students (Akmalia, 2021:41).

Based on description above, research this aim for describe influence method mind mapping type mind map syllabus to ability solving problem mathematics on matter get up room side flat student class VIII SMP Negeri 1 Karangreja Regency Purbalingga.

B. Methods

Study This use method quantitative, type his research that is study experiment (quasi experiment) because There is influence (treatment) given certain. The intended treatment that is method mind mapping type mind map syllabus. Form design from study This is pre-test-posttest only control group design (Putu Ade and Gusti Agung, 2018: 10).

Table 1 Pretest-posttest only control group design format

Group	Pre-test	Treatment	Post-test
Experiment	T_1	X	T_2
Control	T_1	-	T_2

Description:
X: Treatment with use method mind mapping type mind map syllabus
T_1: Pretest
T_2: Post test

Study this conducted at SMP Negeri 1 Karangreja Regency Purbalingga and held in the even semester year 2022/2023, from March 16 to 31, 2023. Population in study this is whole student class VIII SMP Negeri 1 Karangreja Regency Purbalingga which has 5 classes. Sample in study this 2 classes are selected in a manner random use technique simple random sampling because of average ability student relatively same. As for the selected class that is class VIII A as class experiment and class VIII B as class control. Study this involve two deep class learning is given treatment different, where class experiment use method mind mapping type mind map syllabus whereas class control use method lecture.

Data collection techniques used in study This that is test made in form description. test used form pretest and posttest for know ability solving problem mathematics before and after learning with different treatment. Obtained data analyzed with using the N-Gain test and t test. The N-Gain score is done with do comparison from difference score pretest and posttest with difference ideal score and pretest. T test was performed for know influence method mind mapping type mind map syllabus to ability solving problem mathematics with compare results class average N-Gain value experiment and class control.

C. Results and Discussion

1. Results

Instruments used in study This that is t es description composed students of 4 items question with material get up room side flat cubes and blocks. Researcher do a validity test covers validity construction (construct validity) and validity content (content validity) obtained from opinion expert. For measure ability solving problem mathematics student before learning with different treatment, students given especially about the pretest first. As for the class pretest value data experiment and class control as following:

Table 2 Comparison results pretest class experiment and class control

No	Information	Pretest	
		Experiment	Control
1.	Top Rated	41.67	41.67
2.	Lowest Value	29,17	29,17
3.	Amount Student	26	22
4.	Average	33,25	33.05

Based on table on can is known that mark pretest from class experiment and class control before giving treatment different. Top rated from class experiment is 41.67, value lowest is 29.17 with the average value of 26 students is 33.25. Whereas for class control mark highest is 41.67, value the lowest is 29.17 with an average value of 22 students is 33.05. From these data can concluded that second class obtain nearly average value same and no own that difference too significant.

Then, after given learning with different treatment, students given question posttest. Following value data is presented posttest class experiment and class control:

Table 3 Comparison results posttest class experiment and class control

No	Information	Posttest	
		Experiment	Control
1.	Top Rated	87.5	81.25
2.	Lowest Value	70,83	50
3.	Amount Student	26	22
4.	Average	79.97	68,94

Based on table on can is known that mark posttest from class experiment and class control after being given treatment different. Top rated from class experiment is 87.5, value lowest is 70.83 with the average value of 26 students is 79.97. Whereas For class control mark highest is 81.25, value lowest 50 with an average value of 22 students is 68.94. From these data can concluded that grade point average experiment more tall compared to grade point average control.

For know enhancement ability solving problem mathematics student each indicator, following served achievement each indicators obtained from pretest and posttest results.

Table 4 Improvement Experimental Class Indicator

Indicator Ability Solving Problem Mathematics	**Percentage results pretest**	**Percentage results Posttest**	**Percentage enhancement**
Understand Problem	44.83%	100%	55.17%
Strategize or Plan Completion Problem	55.42%	91.33%	35.91%
Finish Problem	32.08%	74%	41.92%
Inspect repeat answer	0.33%	54.50%	54.17%
Average			46.79 %

From table, obtained that indicator understand problem increase more height and indicator strategy or plan settlement problem lowest increase.

Next, following is upgrade data achievement each indicator ability solving problem mathematics students in class control:

Table 5 Improvement Control Class Indicator

Indicator Ability Solving Problem Mathematics	Percentage results pretest	Percentage results Posttest	Percentage enhancement
Understand Problem	44.67%	95.83%	51.16%
Strategize or Plan Completion Problem	53%	80.67%	27.67%
Finish Problem	34.50%	58.33%	23.83%
Inspect repeat answer	0%	40.92%	40.92%
Average			35.90%

From table, obtained that indicator understand problem increase more height and indicator strategy or plan settlement problem lowest increase.

Once obtained pretest and posttest data information then N-Gain test, normality test, homogeneity test, and t test were carried out.

Statistical data acquisition associated N-Gain scores with ability solving problem mathematics students in class experiment served in table following:

Table 6 Statistical data class N-Gain scores experiment

Ability N-Gain Score Data Solving Problem Mathematics Student	
Amount student	26
Highest score	0.79
Lowest score	0.56
Average	0.70

Based on table can we know that the average value of N-Gain class experiment is 0.70 which means there is enhancement ability solving problem mathematics student use method mind mapping type mind map syllabus.

Next is statistical data acquisition associated N-Gain score with ability solving problem mathematics students in class control served in table following:

Table 7 Statistical data class N-Gain score control

Ability N-Gain Score Data Solving Problem Mathematics Student	
Amount student	22
Highest score	0.71
Lowest score	0.29
Average	0.54

Based on table can we know that the average value of N-Gain class control is 0.54 which means no there is significant change to enhancement ability solving problem mathematics student with use method lecture.

Normality test is the prerequisite test used for know normal or nope something data distribution. Normality test used by researchers is with the Shapiro Wilk test because amount sample not enough of 50. Application to the Shapiro Wilk test is If significance (p-value) $< \alpha = 0.05$ means the data is not normally distributed and if significance (p-value) $\geq \alpha = 0.05$ means the data is normally distributed (Putu Ade and Gusti Agung, 2018:46). Research test results This as following:

Table 8 Normality test results

Tests of Normality				
		Shapiro-Wilk		
Class		Statistics	Df	Sig.
Gain Score	Experiment	0.923	26	0.053
	Control	0969	22	0.685
*. This is a lower bound of the true significance.				
a. Lilliefors Significance Correction				

Based on normality test results with Shapiro Wilk use the N-Gain value, accordingly with table above shows that mark probability (Sig) is over big from alpha values are 0.053 > 0.05 and 0.685 > 0.05 meaning that the data is normally distributed.

Homogeneity test is the test used for know uniform data set or the variance homogeneous (Putu Ade and Gusti Agung, 2018:46). Homogeneity test using SPSS version 25. With criteria testing If sig value < α = 0.05, then data variation is not homogeneous, if sig value ≥ α = 0.05, then homogeneous data variations. Following is hypothesis test results from study this:

Table 9 Homogeneity test results

Test of Homogeneity of Variances					
		Levene Statistics	df1	df2	Sig.
Gain Score	Based on Means	3,373	1	46	0.073

Based on table show that the homogeneity test use the N-Gain value is obtained more sig value big from the alpha value is 0.073> 0.05 which means H0 is accepted and H1 is rejected that is homogeneous data variations.

T test was performed for know is there is influence from method mind mapping type mind map syllabus to ability solving problem math. Study This using the independent sample t test (independent sample t test) to test the hypothesis. The t-test hypothesis is as follows:

H0 : $\mu 1 = \mu 2$ (Average ability value solving problem mathematics student class the same with ability average value solving problem mathematics class control).

H1 : $\mu 1 \neq \mu 2$ (Average ability value solving problem mathematics student class experiment no the same with ability solving problem mathematics class control).

Description:

$\mu 1$: The average value of ability solving problem mathematics experimental class.

$\mu 2$: The average value of ability solving problem mathematics class control.

Test criteria if sig value < α = 0.05, then H0 is rejected and H1 is accepted, vice versa if sig value ≥ α = 0.05, then H0 is accepted and H1 is rejected. As for the results from sample t test independent for N-Gain scores that have done using SPSS version 25 as following:

Table 10 Independent Samples Test t-test results

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Q	Df	Sig. (2-tailed)	Mean Differences	std. Error Difference	Lower	Upper
Gain Score	Equal variances assumed	3,373	0.073	6.134	46	0.000	0.16171	0.02636	0.10865	0.21478
	Equal variances not assumed			5,908	33,954	0.000	0.16171	0.02737	0.10608	0.21735

Based on the results of the independent sample t test using the SPSS version 25 program above, it can be seen that the sig (2-tailed) value obtained from the NGain value is 0.000. The sig (2-tailed) value is 0.000 < 0.05, then H0 is rejected and H1 is accepted. This shows that the N-Gain scores of the experimental class and the control class are significantly different. Where the average N-Gain value for the experimental class is 0.70, it is greater than the average N-Gain value for the control class, namely 0.54. It can be interpreted that the syllabus type mind mapping method has an influence on students' mathematical problem solving abilities.

2. Discussion

Study this done for know is there is influence or no from application method mind mapping type mind map syllabus to ability solving problem mathematics material get up room side flat in class VIII SMP Negeri 1 Karangreja Regency Purbalingga. In implementation study use two class as sample study that is class VIII A and class VIII B, where class VIII A as class experiment and class VIII C as class control. In implementation research, later will given different treatment between class experiment and class control. Experiment class will given treatment use method mind mapping type mind map syllabus and class control use method lecture. The material taught at SMP Negeri 1 Karangreja is material in the even semester that is get up room side flat. As for the things studied in study This is ability solving problem mathematics student.

Based on results research that has done, is known that class experiment totaling 26 students with mark the highest pretest is 41.67 and the value the lowest is 29.17 with an average value of 33.25. Whereas class control with a total of 22 students mark highest pretest is 41.67 and value the lowest is 29.17 with an average value of 33.05. From the results pretest second class the show that ability solving problem mathematics student class experiment and class control in relative condition the same.

Once given different treatment in learning, next is gift the posttest was carried out for know results from treatment that has given. From the results posttest class experiment that is

class VIII A was obtained mark highest is 87.50 and value lowest 70.83 with an average of 79.97. Whereas class posttest results control that is grade VIII B grades highest is 81.25 and value the lowest 50 with an average of 68.94. From the results the can is known that there is significant difference from results posttest second class.

Besides it, for know enhancement ability solving problem math too reviewed from each the indicator. On class experiment, the average percentage of ability solving problem mathematics indicator understand problem at first by 44.83% to 100% meaning there is enhancement of 55.17%, indicator strategy or plan settlement problem at first by 55.42% to 91.33% meaning there is enhancement of 35.91%, indicator finish problem at first by 32.08% to 74% meaning there is enhancement of 41.92%, and indicators inspect repeat answer at first by 0.33% to 54.5% mean There is enhancement of 54.17%.

On class control, the average percentage of ability solving problem mathematics indicator understand problem at first by 44.67% to 95.83% meaning there is enhancement by 51.16%, indicator strategy or plan settlement problem at first by 53% to 80.67% meaning there is enhancement of 27.67%, indicator finish problem at first by 34.5% to 58.33% mean there is enhancement of 23.83%, and indicators inspect repeat answer at first by 0% to 40.92% meaning there is enhancement of 40.92%.

After getting results, next ie hypothesis testing is done with using the normalized N-Gain test by t test. Before that normality test and homogeneity test were carried out use N-Gain value. From the results analysis of normally distributed data with (p-value) $\geq \alpha = 0.05$, namely $0.053 > 0.05$ and $0.685 > 0.05$. Data is also homogeneous with sig value $0.073 > 0.05$. From the N-Gain data obtained class control get an average of 0.54. With thus $0.7 > 0.54 > 0.3$ and if categorized as enter into the category moderate N-Gain value. Meanwhile in class experiment obtained an average N-Gain value of 0.70 and if categorized as enter into the category high.

Then test the t independent sample test done for test hypothesis with compare class average N-Gain value experiment and class control that has normally distributed. From the results of the t independent sample test using SPSS version 25 was obtained sig.(2-tailed) value of 0.000 which is more small of 0.05, that is There is difference in average ability solving problem mathematics use method mind mapping type mind map syllabus and use method lecture in the learning process math. From the results of the t test, it can be concluded H0 rejected and H1 accepted because it, method mind mapping type mind map syllabus influential to ability solving problem mathematics on matter get up room side flat student class VIII SMP Negeri 1 Karangreja Regency Purbalingga.

This is in line with research conducted by Rahmawati (2019) which stated that the mathematical problem solving abilities of students who received learning using the mind mapping method assisted by Edmodo blended learning improved better than students who received conventional learning. This research is also in line with research by Shubuhan Syukri Hasibuan and Sundut Azhari Hasibuan (2020) which states that learning using the mind mapping method is effective in improving the mathematical problem solving abilities of class X students at MAN 1 Medan. Apart from that, this research is also in line with research by Eva Fitria Ningsih (2023) which states that the mathematical problem solving abilities of students who use the mind mapping learning model are better than conventional learning and students have a positive attitude towards learning mathematics using the mind mapping learning model.

D. Conclusion

Based on research that has done can concluded that there is influence method mind mapping type mind map syllabus to ability solving problem mathematics on matter get up room side flat student class VIII SMP Negeri 1 Karangreja Regency Purbalingga. From the results of the N-Gain class experiment get the average value of 0.70 is entered to in category height, and in class control the average value of N-Gain is 0.54 which is entered to in category medium. With thus, increase ability solving math in class experiment more tall than class control. Where with use method mind mapping type mind map syllabus from fourth indicator ability solving problem math, which increased the most is indicator understand problem. It because with mind mapping, students can learn draft with mapping so that make it easy student for understand problem.

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Ethnomathematics in Batik Making Activities in Saung Baswet, Banjarsari Wetan Village, Banyumas

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Abstract: Ethnomathematics is a discipline that explores the relationship between culture and mathematics. In Indonesia, one culturally rich tradition is batik. The process of creating batik involves various stages that result in diverse motifs unique to each region. This research aims to identify the ethnomathematical aspects related to the practice of batik-making, and the batik motifs, and to analyze the mathematical concepts associated with batik. The research employs a qualitative ethnographic approach. Data is collected through interviews, observations, and documentation, and is subsequently analyzed using data collection methods, data reduction, data presentation, conclusion drawing, and verification. In the process of batik-making at Saung Baswet Village, Banjarsari Wetan, Banyumas, various mathematical activities such as calculations, measurements, designing, and motif placement are discovered. Some mathematical concepts revealed in batik motifs include points, lines, angles, as well as geometric transformations such as translation, rotation, reflection, and dilation. Additionally, there are concepts related to plane figures such as right triangles, rectangles, trapezoids, circles, and polygons, as well as concepts of symmetry, similarity, and congruence.

Keywords: Batik-Making Activities; Ethnomathematics; Mathematics; Batik Motifs.

A. Introduction

Education and culture are two different aspects, but they are closely related. Both can be thought of as two elements that influence and strengthen each other. Culture provides a basis for understanding for education, while education plays an important role in maintaining and preserving culture, because education aims to shape individuals to have culture (Bakhrul Ulum, 2018). Education and culture have a key role in forming national values which influence the formation of individual character based on high cultural values.

The development and preservation of culture is part of the educational process. Mathematics is one of the scientific disciplines in the world of education. Apart from finding solutions to various problems that arise, we can also use mathematics in various aspects of life. As the central point of a learning and teaching process, mathematics lives and develops in community life in accordance with local culture.

Ernest believes that mathematics is the result of social and cultural constructions that are rooted in history and whose existence is reflected in human activities (Wara Sabon, 2017). Therefore, mathematics cannot be separated from the humanities and social sciences, or from

what is considered a part of global human culture influenced by human values, similar to other fields of knowledge. Mathematics has become an inseparable part of human life, often without realizing it, because many daily activities are closely related to mathematics. In other words, mathematics can be considered as a form of human activity.

In fact, mathematics learning in schools is usually known as formal and rigid learning, because it only focuses on what is contained in mathematics textbooks. It is rare to find schools that apply culture or make variations in the learning context. Formal and rigid mathematics learning often makes students reluctant to learn it because it seems boring and less interesting. Moreover, material that is considered difficult and complicated is foreign to everyday life. Therefore, there is a need for an approach and learning that links mathematics with the culture around them.

One way to start formal mathematics teaching that is appropriate to students' development in the concrete operational stage is to apply an ethnomathematics approach, which connects mathematics in the school context with mathematics in contexts outside of school. This is in line with the idea that mathematics which has cultural elements has a significant impact on mathematics learning in schools. This combination of mathematics, culture and education is often known as ethnothematics. The use of an ethnomathematics approach in the mathematics learning process can be a new bridge for educators, increase students' learning motivation, and enrich students' interest and interest in mathematics.

Around us there are many activities that contain mathematics, one of which is the batik activity. Batik is a legacy of Indonesia's ancestors which continues to develop and is in demand by various levels of society. Historically, batik is an icon or symbol of native Indonesian culture. However, previously batik was recognized as a cultural heritage originating from Malaysia. Through various evidence, batik was finally recognized by the United Nations agency for education, science and culture (UNESCO) as Indonesia's original world cultural heritage, precisely on October 2 2009. Based on this decision, Indonesia commemorates "Batik Day" every October 2 (Ari Wulandari, 2011). Therefore, we as Indonesian citizens have an obligation to preserve batik so that it remains sustainable and is not recognized by other nations. In the batik activity there are mathematical concepts that we can use to get to know mathematics. By making batik, people can know that there are elements of mathematics in it.

One of the batik production houses is Saung Baswet, Banjarsari Wetan Village. Saung Baswet is the only batik shop in Sumbang District which produces batik typical of various regions. Saung Baswet Banjarsari Wetan Village has produced various kinds of batik including written batik, stamped batik, natural dye batik, synthetic dye batik, batik tablecloths and even some batik with their own pattern innovations. Looking at the background and thoughts described above, researchers are interested in conducting research on batik activities in Saung Baswet, Banjarsari Wetan Village, Banyumas, which aims to explore mathematical concepts from the initial stages to producing batik cloth in Saung Baswet, Banjarsari Wetan Village, Sumbang District. So therefore,

B. Method

In carrying out this research, the researcher applied qualitative research methods. This qualitative method is based on postpositivism or interpretive philosophy, used to study natural

or natural situations of objects (Sugiyono, 2017). According to Farida, qualitative research is a type of research that produces findings without using statistical or quantitative steps to obtain them (Farida Nugrahani, 2010).

Researchers use an ethnographic approach, the results of the findings will be in natural form and not determined by numbers or statistics. Derived from Greek which consists of the word 'ethnos' which means 'people', 'cultural group', 'culture'. Where culture here is explained as everything learned, routines and values. The assumption is that humans always exist in their culture (JR. Racao, 2010).

One important factor that researchers must know is that they must master culture, because qualitative methods aim to capture meaning. Seeking understanding or insight into culture in a particular community group is the goal of ethnography (JR. Raco, 2010). This research aims to describe, describe and analyze mathematical activities in batik activities and mathematical concepts in batik motifs in Saung Baswet, Banjarsari Wetan Banyumas Village using an ethnographic approach.

This research was carried out by tracing or digging or exploring some information through observations at Saung Baswet Banyumas, interviews with resource persons, namely batik makers and the head of Saung Baswet as well as documenting it. The results obtained from this data will then be reduced to selecting and processing the data needed and eliminating data that is not needed by the researcher. Then, the researcher will present, analyze and draw conclusions based on the data.

Data analysis is carried out from the time the researcher formulates and explains the problem, before going directly to the field and continues until the process of writing up the research results (I Made Laut Mertha Jaya, 2020). Data analysis carried out before data collection aims to determine the focus of the research, but is temporary. After the researcher collects various data starting from observations, interviews, and documentation, the researcher will analyze the development of temporary data while in the field. The analysis stage includes data reduction, data presentation and data verification.

C. RESULTS AND DISCUSSION

1. Analysis of Mathematical Activities in Batik Making Activities at Saung Baswet Banyumas

Based on the introduction of batik activities in Saung Baswet by collecting data through interviews and observations, researchers found mathematical activities in batik activities. The data analysis is presented in table 1.

Table 1. Analysis of Mathematical Activities in Batik Making Activities in Saung Baswet

Batik Activities	Math Activities
Observe the process of determining the materials and tools needed to make batik	Count
Observe the process of determining the cloth to be used for batik	Measuring, Counting
Observe the processing process of the cloth that will be used for batik	Counting, Measuring
Observe the process of making batik motifs/patterns	Measuring, Designing, Placing
Observe the process of determining the wax/wax needed to make batik	Count

Batik Activities	Math Activities
Observe the process of determining the dyes needed in the coloring process	Counting, Measuring
Observe the process of determining additional medications required for the locking process	Counting, Measuring
Observe the process of determining the water needed in the process"nglorod"	Measuring, Counting
Observe the process of determining the time for making batik cloth	Count

From the data in table 1, it can be seen that in the batik activity there is a mathematical activity. Calcullating activities are found in the process of determining the materials and tools needed to make batik, which involves the process of adding up certain values to determine the number of objects, in this case the materials and tools used in making batik such as one batik stamp, one frying pan, one ruler, two canting. Second, in the process of determining the cloth that will be used for batik, which involves the process of dividing certain values to determine the quantity of an object, in this case, for example, in one roll measuring 100 meters, if you want to make 2 meters of batik cloth, it will produce 50 sheets. cloth. Third, in the process of processing the cloth that will be used for batik, which involves the process of dividing certain values to determine the quantity of an object, In this case, for example, in one roll measuring 100 meters, if you want to make 2 meters of batik cloth, you will produce 50 pieces of cloth. Fourth, in the process of determining the wax/wax needed for batik, which involves the process of adding up certain values to determine the quantity of an object, in finding out how much wax is needed, such as one cloth requires 8-10 ounces of wax. Fifth, in the process of determining the dye needed in the dyeing process, it involves an addition process, such as the blue color needed for 50 fabrics, namely 1,250 grams, 250 cc WAHS matexil, mixed with 50 liters of water, adding 100 grams of table salt and 100 grams of soda ash. . Sixth, in the process of determining additional drugs required, the locking process involves a comparison process, For example, for 1 kg of water glass we usually use a mixture of 2 liters of water, meaning the ratio between the water glass and the water used is 1:2. Apart from the comparison process, the division process is also used as previously explained, for one Aqua bottle, 500 ml of water is used. Seventh, in the process of determining the water needed in the "nglorod" process, it involves an addition process, namely 40 to 45 liters. Finally, in the process of determining the time for making batik cloth, namely in one month producing 10 batik cloth. Seventh, in the process of determining the water needed in the "nglorod" process, it involves an addition process, namely 40 to 45 liters. Finally, in the process of determining the time for making batik cloth, namely in one month producing 10 batik cloth. Seventh, in the process of determining the water needed in the "nglorod" process, it involves an addition process, namely 40 to 45 liters. Finally, in the process of determining the time for making batik cloth, namely in one month producing 10 batik cloth.

Measuring activities are contained in the process of determining the cloth that will be used for batik, namelyinvolves the concept of measurement and practicing critical mathematical thinking skills, in this case determining the size of the cloth, measuring the length and width, such as when making a robe or bottom and top, you can use a cloth size of 2 meters x 115 centimeters. Second, in the process of processing the cloth that will be used for batik, it involves the concept of measurement, in this case measuring the liquid capacity or the amount of material used, such as 90 liters of water, measuring the weight of alum as much as 625 grams

and soda ash as much as 190 grams. Third, in the process of making batik motifs/patterns, it involves measuring concepts such as measuring the length of the baking pan to be used with a size of 40 centimeters. Fourth, in the process of determining the dye needed in the coloring process, which involves the concept of measurement, in this case measuring the capacity of the liquid used, such as in a bottle of aqua containing 500 ml of water, measuring the weight for the number of colors such as 1,250 grams of blue dye. Fifth, in the process of determining additional drugs required, the locking process involves a measurement concept such as four bottles of aqua used to measure 2 liters of water. Finally, the process of determining the time for making batik cloth involves measurement concepts such as the size of the pan used, 45 cm x 30 cm and liters which indicate the size of the water used, namely 40 to 45 liters. In the process of determining additional drugs required, the locking process involves measurement concepts such as four Aqua bottles used to measure 2 liters of water. Finally, the process of determining the time for making batik cloth involves measurement concepts such as the size of the pan used, 45 cm x 30 cm and liters which indicate the size of the water used, namely 40 to 45 liters. In the process of determining additional drugs required, the locking process involves measurement concepts such as four Aqua bottles used to measure 2 liters of water. Finally, the process of determining the time for making batik cloth involves measurement concepts such as the size of the pan used, 45 cm x 30 cm and liters which indicate the size of the water used, namely 40 to 45 liters.

Design activity, in the process of making batik motifs/patterns, namely motifsUse wax in the cloth according to the pattern that has been made using a pencil. The placing activity, in the process of making batik motifs/patterns, is depicting the main pattern or motif on the main side of the cloth plus complementary motifs around the main motif. This is in line with previous research carried out by Faradita Dwi Indah Sari. That there are calculating, measuring and designing activities in batik activities. For activities, I agree with Hanifah Nur Rohma's research as well as research from Maya Modigliani Azra. The difference is that in this study, placing activities were found in batik activities.

2. Analysis of Mathematical Concepts in Batik Motifs in Saung Baswet Banyumas

Based on the introduction of batik motifs in Saung Baswet Banyumas, it shows that the batik motifs in Saung Baswet contain mathematical concepts. These include points, line segments, angles, geometric transformations (translation, rotation, reflection, dilation), flat figures (right triangle, rectangle, trapezoid, circle, polygon), symmetry, similarity and congruence. The mathematical concepts in the batik motifs in Saung Baswet are guided by groups of data formulated from data obtained from research results in the field which can be seen in table 2.

Table 2. Analysis of Mathematical Concepts in Batik Motifs

Mathematical Concepts	Batik Motif
Point	Lumbon motif, machete motif for IAI Temanggung branch administrators
Line Segments	Lumbon motif
Corner	Lumbon motif, machete motif for IAI Temanggung branch administrators

Mathematical Concepts	Batik Motif
Translation (Shift)	The parang motif of the IAI Temanggung branch administrator, the Brambang motif, the Kamaratih Kamajaya motif, the Saung Baswet motif, the leaf collection motif, and the Bodhi leaf motif.
Rotation (Spinning)	Brambang motif
Reflection (Mirror)	Kamaratih kamajaya motif, Saung Baswet motif
Dilation (Enlargement/reduction)	The machete motif of the IAI Temanggung branch administrator
Right triangle	Lumbon motif
Rectangle	Saung Baswet motif
Trapezium	Saung Baswet motif
Circle	The machete motif of the IAI Temanggung branch administrator
Polygon	The machete motif of the IAI Temanggung branch administrator
Symmetry	Baswet saung motif
Congruence	Kamaratih kamajaya motif, Saung Baswet motif
Congruence	Saung Baswet motif, leaf collection motif, and bodhi leaf motif.

Data analysis was carried out based on the documentation that researchers obtained while conducting research in the field. The results of data analysis regarding mathematical concepts in batik motifs in Saung Baswet will be explained by researchers as follows:

a. Concept of Points and Line Segments

Based on the findings of a study on batik motifs in Saung Baswet, there is a mathematical concept, namely the dot concept in the lumbon motif and parang motif of the IAI Temanggung Branch. In the batik making process, dots are an important element. Because, batik itself is a word that comes from the words amba and dot. In its development, batik is referred to as the activity of drawing on a large or wide cloth by connecting certain points (Ari Wulandari, 2011). The concept of line segments is found in the lumbon motif. The line segments in this motif are two parallel lines. The lumbon motif has two parallel lines which are components of a line whose base and end are limited by 2 points.

The following will explain the concept of points and line segments found in batik motifs:

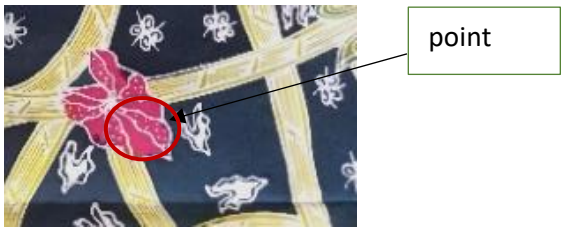

Figure 1. Point concept in the Lumbon motif

Figure 2. Point concept on the Parang Motif of IAI Temanggung Branch Management

Figure 3. The concept of line segments in the Lumbon motif

b. Corner Concept

Based on the findings of a study conducted on batik motifs in Saung Baswet, the corner concept appears in the lumbon motif and Parang motif of IAI Temanggung Branch. An angle is formed from the meeting of two lines that are not opposite and have adjacent starting points.

In the lumbon motif, the leaf buds form an acute angle, namely an angle less than 90°. Meanwhile, in the Parang IAI Temanggung Branch motif, it forms an obtuse angle whose size is more than 90°. The following will explain the concept of corners in batik motifs:

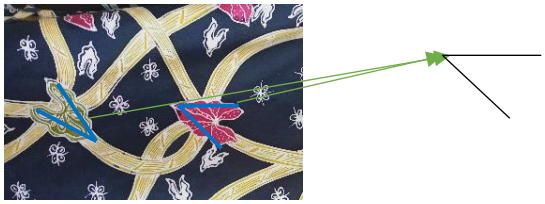

Figure 4. Corner concept in Lumbon motif

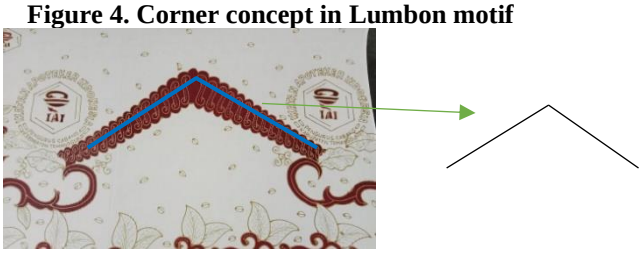

Figure 5. The concept of angles in the IAI Parang Motif, Temanggung Branch

c. Transformation Concept

Based on the findings of a study conducted on batik motifs in Saung Baswet, the concept of transformation appears in several motifs. A transformation in a plane is a bijective function (one-to-one correspondence) between two sets of points in the related plane (Antonius Cahya Prihandoko, 2005). Transformations in the plane are divided into four, namely translation (shift), rotation (rotation), reflection (mirror), and dilation (enlargement or reduction).

In the Parang IAI Temanggung Branch motif, Kamaratih Kamajaya Motif, Brambang Motif, Saung Baswet Motif, Leaf Collection Motif, and Bodhi Leaf Motif, there is a concept of translation or shift. These motifs are made by tracing the pattern on the fabric repeatedly vertically or horizontally with the same shape and size without changing the shape and size. Below we will explain the concept of translation or shift that appears in batik motifs.

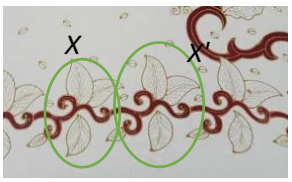

Figure 6. The concept of translation in the IAI Parang Motif, Temanggung Branch

Figure 7. The concept of translation in the Kamaratih Kamajaya motif

Figure 8. The concept of translation in the Kamaratih Kamajaya motif

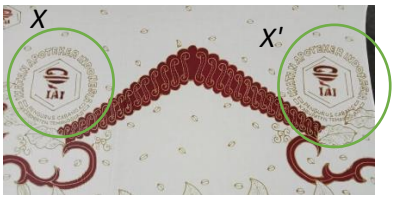

Figure 9. The concept of translation in the IAI Parang Motif, Temanggung Branch

Figure 10. The concept of translation in the Brambang motif

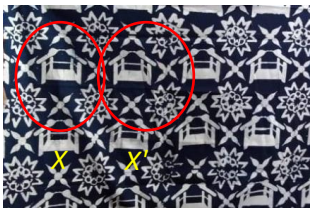

Figure 11. The concept of translation in the Saung Baswet motif

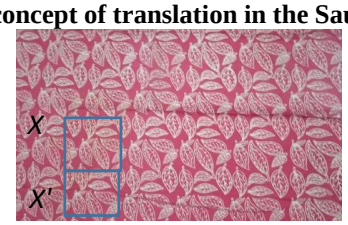

Figure 12. The concept of translation in the leaf collection motif

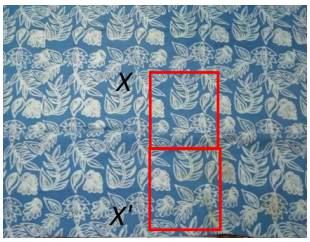

Figure 13. Concept of Translation in the Bodhi Leaf Motif

In the Brambang batik motif, the concept of rotation or rotation is found. The brambang part is rotated by 90˚ which is aligned clockwise to the center point (0,0). Rotation is negative because it is clockwise. The concept of rotation or rotation appears in the following saung brambang motif:

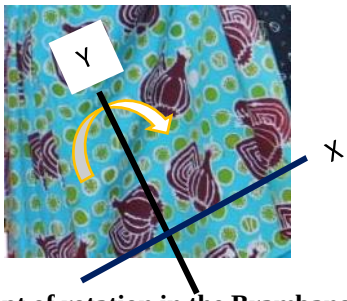

Figure 14. The concept of rotation in the Brambang motif

Displacement of plane points in mirror-like reflection. The result will be the opposite or inverted from the original point, but the size and shape will remain and be congruent. In the Kamaratih Kamajaya motif, the concept of reflection is found, where the batik maker makes a pattern on the cloth and copies the pattern horizontally. The concept of reflection or mirroring appears in the following motifs:

Figure 15. The concept of reflection in the Kamaratih Kamajaya motif

Figure 16. Reflection concept in the Saung Baswet motif

Dilation is a change in the distance of points with a certain multiplier factor to a certain point of a transformation. The size of a shape can change when it is enlarged or reduced (dilation). However, dilation does not result in a change in the shape of a shape (Istiqomah, 2020). In the Parang IAI Temanggung Branch motif, the concept of dilation, namely reduction, is found. The parang motif consists of several similar machete shapes. In the middle of the motif, there are two large machete shapes which are then reduced downwards to the bottom right and bottom left to form like mountains. If the original image has a value of 1, then the next form of motif has a value of $k<1$. The concept of dilation appears in the following motif.

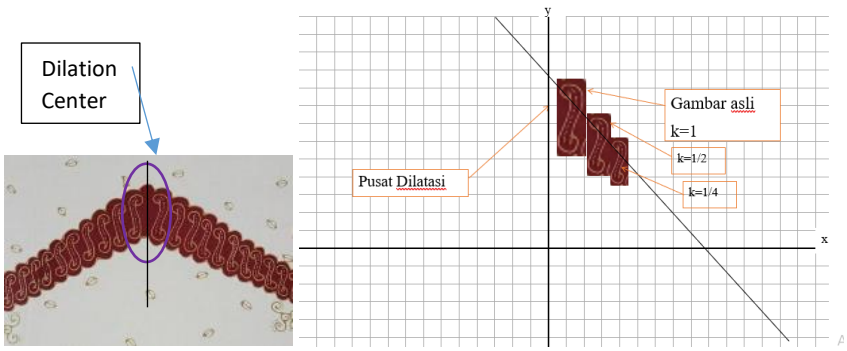

Figure 17. Dilation concept in the IAI Parang Motif, Temanggung Branch

d. Flat Build Concept

Based on the findings of a study conducted on batik motifs in Saung Baswet, the flat concept appears in several motifs. The flat shapes found are right triangles, rectangles, trapezoids, circles and polygons. A right triangle is a type of triangle whose angles are right angles with a measure of 90° and has one hypotenuse and two perpendicular sides. The next flat shape is a rectangle, where the opposite sides are the same length and the four corners are right angles. A trapezoid is a type of flat shape that has two parallel sides of different lengths and the angles do not form right angles. A circle is a flat shape where all points on the circle are the same length as the center point (P) and have a diameter and radius (A. Marini, 2013).

The concept of a right triangle is found in the lumbon motif, the concept of a rectangle is found in the Baswet saung motif, the trapezoid concept is found in the Baswet saung motif, the circle concept is found in the parang motif of the IAI Temanggung branch administrators, and the polygon concept is found in the parang motif of the IAI Temanggung branch administrators. Below we will explain the concept of flat shapes in batik motifs.

Figure 18. The concept of a right triangle in the Lumbon motif

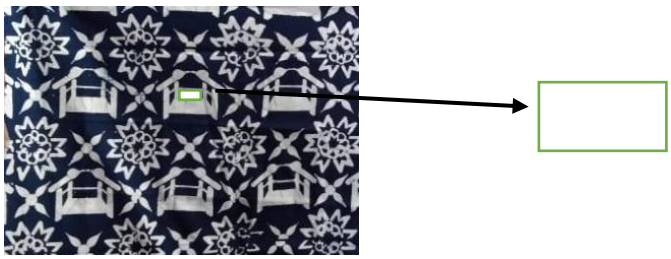

Figure 19. Rectangular concept in the Saung Baswet motif

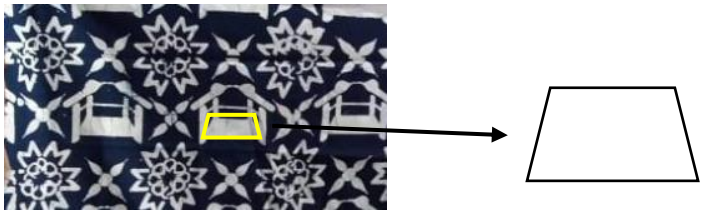

Figure 20. Trapezoid concept in the Saung Baswet motif

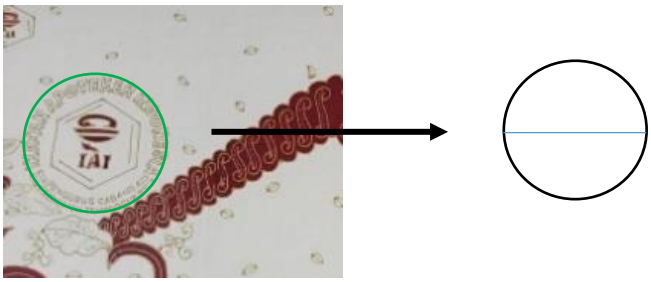

Figure 21. Circle concept in the machete motif of IAI Temanggung Branch administrators

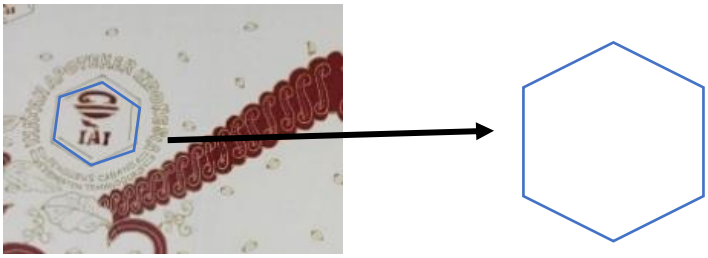

Figure 22. Polygon concept in the machete motif of IAI Temanggung Branch administrators

e. Symmetry Concept

Fold symmetry is the application of mirroring to a flat shape (Antonius Cahya Prihandoko, 2005). Based on the findings of a study conducted on batik motifs in Saung Baswet, the concept of folded symmetry appears in the saung Baswet motif.

Figure 23. The concept of folded symmetry in the Saung Baswet motif

f. Concept of Congruence and Congruence

Based on the results of research at Saung Baswet, the concept of congruence was found in the lumbon motif. In this motif there are large lumbon and small lumbon shapes. As for making small lumbon patterns, adapt them to the size of large lumbons, so that the two lumbon shapes can be said to be similar lumbons. The following is the concept of congruence in batik motifs.

Figure 24. Concept of Congruence in the Lumbon Motif

Based on the results of research at Saung Baswet, motifs were found that were the same in shape and size, namely the saung Baswet motif, the leaf collection motif, and the bodhi leaf motif. This motif is made by tracing the previous pattern, resulting in a pattern that is the same in shape and size.

Figure 25. The concept of congruence in the Saung Baswet motif

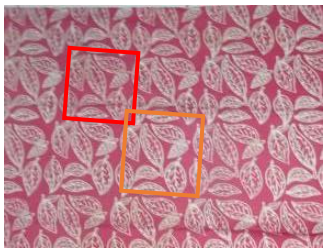

Figure 26. The concept of congruence in the leaf collection motif

Figure 27. Concept of Congruence in the Bodhi Leaf Motif

3. Discussions

Apart from being a scientific discipline in education, mathematics can be a tool for finding solutions to various problems. In addition, mathematics can be used in various aspects of life. This is in line with Ernest's statement, mathematics is a socio-cultural construction where mathematics is contained in history whose existence is in human activity (Wara Sabon, 2017).

However, in reality learning mathematics is synonymous with formal, rigid and monotonous lessons stuck to the material in textbooks. It is rare to find schools that apply culture in learning. Culturally nuanced mathematics is one variation that can play a role in

school mathematics. The combination of mathematics, culture and education is usually known as ethnomathematics. The process of learning mathematics using ethnomathematics becomes a new link for an educator, so that it will increase learning motivation for students, attracting more students' attention and interest in liking mathematics. Apart from that, ethnomathematics can provide an understanding of mathematics to the public and provide an explanation that mathematics is so close to humans.

From the results of this research, it is proven that there is mathematics in culture, namely in batik activities and batik motifs which can increase knowledge about mathematical activities and mathematical concepts, especially related to geometry.

D. Conclusion

By referring to the findings, analysis and discussion that have been described previously, it can be concluded that there is ethnomathematics in batik activities in Saung Baswet, Banjarsari Wetan Village, Banyumas, namely mathematical activities and there are mathematical concepts in the batik motifs of Saung Baswet, Banjarsari Wetan Village, Banyumas. The following is a summary of this research:

(1) Based on data identification, there are mathematical activities in batik activities in Saung Baswet, Banjarsari Wetan Banyumas Village, including calculating, measuring, designing and placing activities. (a) Counting activities involve the process of adding certain values to determine the amount of materials and tools used in making batik, the process of dividing certain values to determine the number of an object, the process of comparing certain values to determine the difference in the values of two numbers. (b) Measuring activities involve measurement concepts and practice critical mathematical thinking skills such as measuring the length and width of the tools used for batik, the capacity of liquids or the amount of materials used. (c) Design activities involve problem solving and using mathematical concepts to create something that integrates creativity, analytical thinking and understanding mathematics in the context of designing and making batik motifs. (d) Placing activities relate to determining the position or location of objects or points in a given reference frame in making batik patterns or motifs, involving the use of mathematical concepts such as coordinates, geometry and distance calculations.

(2) Mathematical concepts contained in batik motifs in Saung Baswet, Banjarsari Wetan Village, Banyumas include the concept of points and line segments, the concept of angles, the concept of geometric transformation consisting of translation/shift, rotation, reflection/reflection and dilation, the concept of flat figures. such as right triangles, rectangles, trapezoids, circles and polygons, the concept of symmetry, and the concepts of similarity and congruence.

From the results of this research, it can be concluded that mathematics does not only exist in books and learning at school, but in culture and everyday life. Ethnomathematics proves that mathematics also exists in culture, such as in batik activities in Saung Baswet, Banjarsari Wetan Village, Banyumas and mathematical concepts in the batik motifs of Saung Baswet, Banjarsari Wetan Village, Banyumas. Apart from that, the existence of ethnomathematics can be an innovation for educators in explaining mathematics learning material that is more

interesting and new for students, so that learning mathematics is more fun and can increase students' interest in studying mathematics.

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The Effect of Think Pair Share Learning Model with the Help of Geogebra Software on Students' Mathematical Communication Skills

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Abstract: The background of this study was the lack of mathematical communication skills of students. Researchers chose the think pair share of cooperative learning model with the help of GeoGebra software to overcome this students' lack of mathematical communication skills. The purpose of this study was to determine the implementation and whether there was an influence of the think pair share of the cooperative learning model with the help of GeoGebra software on students' mathematical communication skills. This research was a type of quasi-experimental research and the design used was the pretest-posttest control group design. The population of this study was 320 students of the eighth grade at MTs Negeri 1 Purbalingga. The research sample was 40 students of VIII A as a control class and 39 students of VIII B as an experimental class. Based on the analysis of observation sheet data, an average value of 3.38 was obtained and was located at intervals of $3.25 \leq x \leq 4.00$ which was classified as very good. Based on the results of the t-test against the post-test results that had been done, the value of Sig. $0.000 < 0.05$ which showed that there was an average difference in mathematical communication skills between the experimental class and the control class. This study concludes that the implementation of the think pair share learning model with the help of GeoGebra software is very good, it can affect the improvement of students' mathematical communication skills.

Keywords: Geogebra Software; Mathematical Communication Skills; Think Pair Share.

A. Introduction

Mathematics is one of the sciences that underlies the development of modern technology and is able to develop a human mindset so that it has a role in improving the quality of human resources. With mathematics, humans have a mindset that makes sense and are able to communicate a series of symbols and ideas to others (Hendriana, 2019:4).

In KTSP (2006) which has been refined in the 2013 Curriculum, mathematics learning in schools has the aim that students are able to: 1) understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms flexibly, accurately, efficiently, and precisely in problem solving, 2) use reasoning on patterns and properties, perform mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements, 3) solve problems, 4) communicate ideas with symbols, diagrams, or other media to clarify circumstances or problems, 5) have an attitude of appreciating the usefulness of mathematics in life, have curiosity, attention, and interest in

learning mathematics, as well as a tenacious and confident attitude in problem solving, and 6) use simple and modern teaching aids to carry out mathematical activities (Hendriana, 2019:7).

The objectives of mathematics learning listed in the 2013 curriculum above, there are two important points, namely mathematics learning aims to make students able to communicate ideas with symbols, tables, diagrams, or other media to clarify situations or problems and use simple and modern teaching aids to carry out mathematical activities. This shows that mathematical communication skills are one of the essential basic mathematical skills that must be possessed by high school students (Hendriana, 2018:59). Through a good mathematical communication process, students can use it to convey their ideas or ideas both verbally and in writing with symbols, images, algebraic expressions, graphs, or diagrams in explaining problems or circumstances from the information obtained. Students who have low mathematical communication skills, can certainly have difficulty in conveying their ideas both verbally and in mathematical writing.

The high and low mathematical abilities possessed by students cannot be separated from the process of learning mathematics. The current trend of the learning process is still centered on teachers with a lecture or storytelling learning model. Students are less actively involved in the learning process, so the level of student comprehension of the subject matter is low (Nurfuadi, 2020:143).

The mathematical communication skills of each individual will have an influence on the learning process and outcomes. Mathematics learning requires mathematical communication so that students can construct and communicate mathematical knowledge and mathematical problem solving, organize and combine mathematical ways of thinking, and use mathematical language to express and represent ideas correctly (Hendriana, 2018:60). Therefore, students' mathematical communication skills need special attention to be further developed in mathematics learning.

Indicators of mathematical communication according to the Ontario Ministry of Education quoted by Heris Hendriana, et al., include: a) Written text, which explains the model of the situation or problem using its own language either orally, in writing, graphs, concrete or algebra; explain and make mathematical questions from the material that has been studied; listening, discussing, and rewriting mathematics; determine the relationship between models, constructing arguments, and summing up arguments; b) Drawing, which describes a model of a mathematical situation or problem into visual form (drawing, table, or diagram); and c) Mathematical expressions, which express mathematics or express a model of a mathematical situation or problem into mathematical language or symbols.

Based on observations of mathematics learning at MTs Negeri 1 Purbalingga, it was found that mathematics learning sometimes uses conventional learning models, such as lecture methods, questions and answers and practice questions together. So that the learning is still teacher-centered and does not seem too student-centered. This causes students to act passively. Such a learning model makes students' mathematical skills less honed, especially students' mathematical communication skills. The lack of mathematical communication skills of students can be seen in the student learning process on relation and function material and circle material, where students have difficulty in explaining problem models using their own language and presenting them into visual form (pictures, tables, or diagrams). Students still need help in the form of direction from the teacher to communicate the problem model into

language or mathematical symbols or vice versa. In addition, students also provide less feedback on the presentation of problems given by the teacher, because they are less able to construct arguments on the problem.

To overcome these problems, a learning design is needed that is able to familiarize students to construct their thoughts both with teachers, friends, and mathematical material. One way that can be done to improve students' mathematical communication skills is to use the right learning model, one of which is by group discussion (Abdi, 2018:100). Group discussions can provide opportunities for students to construct their knowledge so that they can understand the concepts taught easily and students are able to communicate mathematical ideas in verbal and written form. To support group discussions can be used by applying a cooperative learning model.

The cooperative learning model is a learning model that allows students to cooperate and interact with fellow students in structured tasks (Ertikanto, 2016:185). This cooperative learning model has several types that can be used for alternative learning models in the classroom. Some cooperative learning models are able to attract students' attention and make them quite active in learning mathematics. In addition, a cooperative learning model that can encourage students to play an active role in class and can improve students' mathematical communication skills is the Think Pair Share type cooperative learning model (Ansari, 2016:91).

This is in line with research conducted by Ika Marantika, et al which states that the mathematical communication skills of students who follow think pair share learning are higher than the mathematical communication skills of students who follow conventional learning (Marantika, 2020:20). On the other hand, research conducted by Davi Apriadi resulted in the conclusion that the cooperative learning model and conventional learning model provide the same results when given to students with high or low learning activities (Apriandi, 2012:14). Based on the two studies that obtained different results, in this study the author will design research using a cooperative learning model of think pair share type.

The think pair share learning model is one of the cooperative learning models which in its application is aimed at influencing student interaction patterns and providing opportunities for them to convey their participation to fellow students and teachers. This model introduces the idea of 'wait or think time'. The interaction process in cooperative learning requires students to communicate directly with other students, give each other information or knowledge and exchange ideas, and practice defending their opinions if they are worth defending (Ertikanto, 2016:186).

Based on the mathematics learning objectives listed in the 2013 curriculum, one of the other important points is to use simple and modern teaching aids to carry out mathematical activities. Therefore, the learning process of think pair share in this research will use geogebra software as a modern teaching aid. Geogebra software is designed as a learning medium used to support mathematics learning activities (Syahbana, 2016:2). Its display is maximally able to help the representation of mathematical concepts in multimode. This software can be installed on a computer or can be accessed online by anyone and can be used at any time (Syahbana, 2016:2). Therefore, this software is very useful for teachers and students to support mathematics learning activities related to geometry, algebra, calculus, linear programs and statistics. There are many menus and tools available in this software. So that with guidance and

direction from the teacher, students will be able to easily use and understand mathematics subject matter.

From the statements above, this study will explain how the implementation of the think pair share cooperative learning model with the help of geogebra software to improve students' mathematical communication skills and whether there is an influence of the think pair share cooperative learning model with the help of geogebra software on students' mathematical communication skills. Based on the problems described above, researchers are interested in conducting an experimental study entitled "The Effect of the Think Pair Share Cooperative Learning Model with the Help of Geogebra Software on the Mathematical Communication Skills of Class VIII MTs Negeri 1 Purbalingga Students".

B. Methods

This research is a type of quasi-experimental research (quasy experimental design) and the design used is the pretest-posttest control group design involving experimental classes and control classes.

Table 1. Research Design

Subject	Initial Test	Treatment	Final Test
Experimental Class	$X_{1(1)}$	A	$Y_{1(1)}$
Control Class	$X_{1(2)}$	B	$Y_{1(2)}$

Information:

$X_{1(1)}$: Initial test for experimental class
$X_{1(2)}$: Initial test for control class
$Y_{1(1)}$: Final test for experimental class
$Y_{1(2)}$: Final test for control class
A : Using the think pair share cooperative learning model with Geogebra Software Help
B : Using conventional learning models

The population in this study is all grade VIII MTs Negeri 1 Purbalingga students who are enrolled in the even semester of the 2022/2023 academic year. There are 8 classes in total and the total number of students is 320 students. Then, the sample in this study will be taken using purposive sampling techniques, Based on the sampling, it was obtained that the experimental class was class VIII B with a total of 39 students, while the class that became the control class was VIII A with a total of 40 students.

The data collection method uses observation and tests. In this study, researchers will implement the think pair share cooperative learning model with the help of geogebra software. Then, researchers will be observed and assessed by observers in the application of this learning model in the classroom. The observer that the researcher chose was one of the mathematics teachers of MTs Negeri 1 Purbalingga and one of the 8th semester students of the mathematics tadris study program UIN SAIZU. The research instrument is in the form of an observation sheet. The test that the researcher will give is in the form of a description test that will be given at the beginning of the study (pre-test) and the end of learning (post-test) in each research class.

This method researchers use to measure the mathematical communication skills of grade VIII students at MTs Negeri 1 Purbalingga. Research instruments in the form of pre-test and post-test that have been tested and tested for validity and reliability. Validity uses the validity of content that is validated directly by experts, namely Muhammad 'Azmi Nuha, M.Pd as a supervisor and lecturer of Tadris Mathematics UIN Prof. K.H. Saifuddin Zuhri Purwokerto and Maresesa Ulfah Nurikasari, S.Pd as a teacher of mathematics subjects MTs Negeri 1 Purbalingga. The average scores for pre-test and post-test were 3.50 and 3.66 and included in the very valid criteria.

The next validity test is the validity of the item using the Pearson Product Moment correlation with significance = 5%, namely rcalculate rtabel then the instrument is valid, while if rcalculate < rtabel then the instrument is invalid. This pre-test and post-test were tested on 40 students, with the help of SPSS 23 for windows, there were 5 valid questions, with r rtable = 0.312. After that, reliability tests were carried out with Alpha Cronbach with the decision criterion being that if the Alpha Croncbach coefficient (r) > 0.60 then it can be said that the instrument is reliable. The results of the pre-test reliability test were 0.731 > 0.60 and 0.643 > 0.60 for the results of the post-test reliability test. So that the instrument is reliable. Based on the validity and reliability test, only 3 out of 5 questions were used with criteria that met each indicator of mathematical communication ability.

After the research process and generating data, the next step is to analyze the data. To analyze the observation sheet, the following scoring guidelines are used.

Table 2 Observation Sheet Scoring Guidelines

Scoring Coefficient	Correlation	Activity Interpretation
$3{,}25 \leq x \leq 4$	Excellent	Carry out activities in accordance with the RPP
$2.5 \leq x < 3.25$	Good	Carry out activities almost in accordance with the RPP
$1.75 \leq x < 2.5$	Enough	Doing activities worse than RPP
$1 \leq x < 1{,}75$	Not enough	Not carrying out activities in accordance with the RPP

And to analyze each pre-test and post-test results using 3 kinds of tests, namely the normality test (Kolmogorov-Smirnov test), homogeneity test (Levene test), and t test. The normality test is used to determine whether the data comes from a normal population, with the test criterion being if the significance level of p-value < $\alpha = 0.05$, then the data is not normally distributed. Meanwhile, if the significance level of p-value $\geq \alpha = 0.05$, then the data is normally distributed (Anwar, 2009:88). Furthermore, the homogeneity test is used to find out whether the variance of data from the analyzed sample is homogeneous or not. The test criteria used are Sig. $\geq$ 0.05, so the data is homogeneous. Meanwhile, if Sig. < 0.05, then the data is inhomogeneous (heterogeneous) (Subando, 2019:36). And the t-test is used to find out the significant difference between the experimental class and the control class. This t-test is done by comparing the calculated values of sig. with a value of 0.05. In this study, for the t test will use the help of SPSS 23 for windows. The test hypothesis carried out is as follows:

H0 is accepted if the calculated value < ttable or the sig value. (2-tailed) > α

H1 is accepted if the calculated value > ttable or the sig value. (2-tailed) < α

If there is an acceptance of H0, it can be concluded that there is no significant effect. Meanwhile, if there is a rejection of H0, it can be concluded that there is an influence of the think pair share cooperative learning model with the help of geogebra software on the mathematical communication skills of grade VIII MTs Negeri 1 Purbalingga students.

C. Results and Discussion

The study was conducted from May 15, 2023, to May 27, 2023. The learning process is carried out in 4 meetings and 2 meetings for pre-test and post-test. The experimental class uses a think pair share cooperative learning model with the help of geogebra software. While the control class uses a conventional learning model. The learning material is relatively the same, namely discussing the surface area of the prism, the surface area of the pyramid, the volume of the prism, and the volume of the pyramid. In this result and discussion, data analysis is assisted by using SPSS 23.0 for windows.

1. Data Analysis of Think Pair Share Cooperative Learning Model Implementation with the help of Geogebra Software

   After observation by observer 1, namely Mr. Ghofur Riyanto as a mathematics teacher and Destiana Herawati as observer 2 who is a student of Tadris Mathematics UIN SAIZU. The results of observations using observation sheets are as follows:

Table 3 Implementation observations

	Observer	Total Score	Value
1	Observer 1	42	3,23
2	Observer 2	46	3,53
3	Score Average	44	3,38

In accordance with the scoring guideline criteria, an average value of 3.38 was obtained and was located at intervals of $3.25 \leq x \leq 4.00$ which was classified as very good. Thus, based on these observations, it can be concluded that the implementation of the think pair share cooperative learning model with the help of geogebra software is carried out very well.

2. Data Analysis of the Effect of Think Pair Share Cooperative Learning Model with the help of Geogebra Software on Mathematical Communication Skills

   The following are the results of pre-test and post-test data analysis after treatment in experimental and control classes:

a. Pre-Test Data Analysis

   Pre-test data of the experimental class and the control class were obtained before the two classes were given treatment by the researcher. Both classes still get the same treatment from math teachers in learning to build flat side spaces (cubes and blocks). The following

are the pre-test results of mathematical communication skills of experimental and control class students:

Table 4 Pre-Test Value Data of Experimental Class and Control Class

		E	C
1	Higest Score	65,2	69,6
2	Lowest Score	39,1	43,5
3	Score Average	51,3	52,9

b. Results and Discussion of Pre-Test Normality Test

The normality test uses the Kolmogorov-Smirnov test with the test criteria used is if the significance level of the p-value < α = 0.05, then H_0 is accepted. Meanwhile, if the significance level of *p-value* ≥ *α* = 0.05, then H_0 is rejected. The results of the pre-test normality test are as follows:

Tests of Normality

	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
PreTest	.098	79	.059	.979	79	.224
a. Lilliefors Significance Correction						

Figure 1. Pre-Test Normality Test Output

Based on the data above, it was found that the significance value of the p-value was 0.059 ≥ 0.05. From the test criteria that have been set, namely the significance of the p-value ≥ α = 0.05, with the decision H_0 rejected, the data is normally distributed. So it can be concluded that the pre-test data is already normally distributed.

c. Results and Discussion of Homogeneity Test & Pre-Test t Test

The homogeneity test uses the levene test, with the test criteria being Sig. ≥ 0.05, then the data is homogeneous. Meanwhile, if Sig. < 0.05, then the data is inhomogeneous (heterogeneous). And for the t test using an independent sample t test. The output of homogeneity test and t test using the help of SPSS 23.0 for windows, as follows:

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper

Pre Test	Equal variances assumed	1.616	.207	1.726	77	.088	5.0685	2.9363	.7785	10.9155
	Equal variances not assumed			1.724	75.685	.089	5.0685	2.9403	.7881	10.9251

Figure 2. Pre-Test t-Test Output

Based on the SPSS output above, it was found that the Sig. value in the levene test was 0.207 ≥ 0.05. So it can be concluded that the pre-test data of the two classes are homogeneous. And the independent sample t test obtained the calculated value of Sig. which is 0.088. Based on the test criteria, the calculated value of Sig. is compared with a value of 0.05. The value of Sig. 0.088 > 0.05, then H_0 is accepted. So it can be concluded that there is no difference in mathematical communication skills between the experimental class and the control class.

d. Post-Test Data Analysis

Post-test data of the experimental class and the control class were obtained after both classes were given treatment by the researcher. The experimental class received treatment using the think pair share cooperative learning model with the help of geogebra software. Meanwhile, the control class received treatment using conventional learning models. The following are the post-test results of mathematical communication skills of class VIII A students as a control class and class VIII B as an experimental class.

Table 5 Post-Test Value Data of Experimental Class and Control Class

		E	C
1	Higest Score	95,7	87,0
2	Lowest Score	60,9	43,5
3	Score Average	80,5	65,9

e. Results and Discussion of Post-Test Normality Test

The results of the post-test normality test are as follows:

Tests of Normality						
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Post Test	.071	79	.200*	.984	79	.426
*. This is a lower bound of the true significance.						
a. Lilliefors Significance Correction						

Figure 3. Post-Test Normality Test Output

Based on the data above, it was found that the significance value of the p-value was 0.200 ≥ 0.05. From the test criteria that have been set, namely the significance of the p-value ≥ α = 0.05, with the decision H_0 rejected, the data is normally distributed. So it can be concluded that the pre-test data is already normally distributed.

f. Results and Discussion of Homogeneity Test & t Test Post-Test

This t test is performed by comparing sig values. with a value of 0.05. H_0 is accepted if the tcount value < ttable or the sig. (2-tailed) value > α. And H_1 is accepted if the tcount value is > ttable or the sig. (2-tailed) value < α. If there is an acceptance of H_0, it can be concluded that there is no difference in the average mathematical communication ability between the experimental class and the control class. Meanwhile, if there is a rejection of H_0, it can be concluded that there is an average difference in mathematical communication skills between the experimental class and the control class. The output of homogeneity test and t test using the help of SPSS 23.0 for windows, as follows:

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Post Test	Equal variances assumed	3.589	.062	6.423	77	.000	14.6276	2.2773	10.0929	19.1622
	Equal variances not assumed			6.451	70.160	.000	14.6276	2.2675	10.1054	19.1497

Figure 4. Post-Test t Test Output

Based on the SPSS output above, it is found that the Sig. value is 0.062 ≥ 0.05. So it can be concluded that the post-test data of the two classes are homogeneous. And Based on the table above, the independent sample t test obtained the calculated value of Sig. which is 0.000. Based on the test criteria, the calculated value of Sig. is compared with a value of 0.05. The value of Sig. 0.000 < 0.05, with the H_1 decision accepted, it can be concluded that there is an average difference in mathematical communication skills between the experimental class and the control class. In other words, it can be concluded that there is an influence of the think pair share cooperative learning model on the mathematical communication skills of grade VIII MTs Negeri 1 Purbalingga students.

D. Conclusion

1. The implementation of the think pair share *cooperative learning model* with the help of *geogebra software* is very well applied as a variation of the mathematics learning model in schools. In addition, variations of this learning model can also improve students' mathematical communication skills. This can be proven by the results of observation sheets that are in accordance with the *syntax of* the think pair share *learning model* with the help of *geogebra software* with an average value of 3.38 and located at intervals of $3.25 \leq x \leq 4.00$ which are classified as very good criteria.
2. There is an influence of *the think pair share* cooperative learning model with the help of *geogebra software* on students' mathematical communication skills. This can be seen from the results of the *independent sample t test* (t-test) which obtained a Sig. (2-tailed) value of $0.000 < 0.05$, then H1 is accepted which means that there is an average difference in mathematical communication skills between the experimental class and the control class. The average *post-test* of mathematical communication skills of experimental class students was 80.5, while the *average post-test* of the control class was 65.9. From these results, it proves that the average mathematical communication ability of experimental class students is higher than that of the control class. Thus, there is an influence of the *think pair share cooperative learning model* with the help of *geogebra software* on the mathematical communication skills of grade VIII MTs Negeri 1 Purbalingga students.

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The Effectiveness of Cooperative Learning Model With Group Investigation (GI) Using Comic Media Towards Mathematical Literacy Ability of VIII Students at SMP Negeri 1 Punggelan

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Abstract: This study aimed to determine the effectiveness of the GI-type cooperative learning model assisted by comic media in improving the mathematical literacy skills of the eighth-grade students of SMP Negeri 1 Punggelan. This research was experimental research with a quantitative approach. The population in this study were students of the eighth grade of SMP Negeri 1 Punggelan and the samples used were taken by simple random sampling technique. The sample results obtained were students of VIII G and VIII H, consisting of 58 students. The instrument used in this study was a description test consisting of a pretest and a posttest. The results of this study showed that the average mathematical literacy ability of students who were subjected to the GI-type cooperative learning model assisted by comic media was better than those who were not subjected to it, as seen from the results of the N-Gain test, namely the experimental class obtained an average N-Gain value of 0 .77 with high criteria, while in the control class, the average N-Gain value for the control class was 0.47 with moderate criteria. In the t-test, the two independent samples showed a significant result of 0.000 <0.05, meaning that there was a significant difference in students' mathematical literacy skills between the experimental and control classes. The GI-type cooperative learning model assisted by comic media was shown to be effective for increasing mathematical literacy skills with the average N-Gain test results obtained in the experimental class by 77% with effective criteria and in the control class by 47% with less effective criteria.

Keywords: Comic media; GI type cooperative learning model; Mathematical literacy ability.

A. Introduction

Mathematics is a way to find answers to problems faced by humans, namely a way of using information, knowledge of shape and size, knowledge of counting. According to Content Standards (SI), the objectives of the mathematics subject show that the curriculum is structured with attention to aspects of mathematical literacy (BSNP, 2006). This is because mathematical literacy is very important for everyone because it can help someone to recognize the role of mathematics in the real world and make the necessary considerations and decisions. Mathematical literacy ability is the ability to formulate, apply, and interpret mathematics in various contexts. With mathematical literacy students can develop and apply mathematical knowledge in the real world. Mathematical literacy emphasizes to students that

mathematics does not only count and master the material, but also pays attention to reasoning in understanding mathematical material, using mathematical concepts, and solving mathematical problems in everyday life.

From the results of the 2018 PISA (Program for International Student Assessment) survey published by the OECD (Organization for Economic Cooperation and Development), it shows that the mathematical literacy abilities of Indonesian students have an average score of 379, while the average from the OECD is 489. ranked 74th out of 79 countries. This shows that the ability of mathematical literacy in Indonesia is still low.

Based on the results of preliminary observations at Grade VIII of SMP Negeri 1 Punggelan, it is known that students at SMP Negeri 1 Punggelan, Punggelan District, Banjarnegara Regency have low mathematical literacy skills. This can be seen from the results of the preliminary test during the observation obtained data that the average value of students' mathematical literacy ability at SMP N 1 Punggelan is 36.25. Some students still cannot understand mathematical concepts and solve mathematical problems related to real contexts. Many students are still passive in mathematics learning activities. Not infrequently students have not been able to answer the questions posed by the teacher while learning is in progress and feel embarrassed to ask the teacher if they have difficulty understanding the material.

This is possible because mathematics learning is still largely teacher-centered so that students' mathematical literacy skills cannot develop. Students should be able to develop their mathematical literacy by seeking information about learning materials and applying mathematical concepts and solving mathematical problems in various contexts by studying independently or in groups. Group learning can be done through a learning model.

The learning model that is suspected to be suitable for increasing students' mathematical literacy skills is the group investigation (GI) cooperative learning model. The use of appropriate learning models can provide a relevant influence on the success of learning mathematics. According to Fauzi (2019), group investigation is a type of cooperative learning model that emphasizes student activity in seeking information and solving problems regarding learning material in groups to increase students' understanding and critical thinking skills regarding subject matter so that it will increase students' mathematical literacy. . With this type of GI learning, students will be more flexible in seeking information in discussions and can ask their friends about material they have not understood. From this, students will seek the necessary information from various sources. This of course will foster students' interest in reading so that it will improve students' mathematical literacy abilities and students play an active role during learning activities.

To support the effectiveness of the GI type cooperative learning model, it is necessary to have learning media. The learning media is used at the implementation or investigation stage. At this stage, students collect information on subject matter from various sources, one of which is learning media. With the help of learning media, it can increase student enthusiasm for learning and make it easier for students to understand the subject matter. One of the learning media that can support mathematics learning to improve mathematical literacy is comic media. Comic media can be used as a source of information in the learning process. Comics not only provide entertaining information but can also be called learning comics if they contain educational information. One of the educational comic media is math comics.

Rosyida (2018) stated that reading comics can foster a critical attitude in children, stimulate interest in reading, provide direction to students who do not like to read so that they are disciplined in reading, and make it easier for students to capture the message or material presented. According to Gafoor (2013), this math comic has an interesting and easy-to-understand storyline. From its distinctive design so that it has great power to convey information that can stimulate student activity and creativity so that it will improve mathematical literacy abilities. The results of Yani Fitriyani's research stated that the use of mathematical comic media can improve mathematical literacy skills in understanding mathematical word problems (Fitriyani, 2021). Likewise the results of Nia Kurniati's research which stated that the average increase in the ability of mathematical literacy of students whose learning used cooperative learning models was higher than the increase in the ability of mathematical literacy of students whose learning used conventional learning models. (Kurniati, 2020).

Based on this background, the researcher is interested in conducting research with the title "Effectiveness of the Group Investigation (GI) Cooperative Learning Model Assisted by Comic Media on the Mathematical Literacy Ability of Class VIII Students of SMP Negeri 1 Punggelan".

B. Method

This type of research is experimental research with a quantitative approach. Quantitative research is research that presents data in the form of numbers and the type of data can be measured or calculated directly using statistical analysis. This study used the Pretest and Posttest Control Group research design. Before conducting treatment to the experimental class and the control class, the researcher gave a pretest first to determine the level of students' mathematical literacy ability, then was given a mathematical treatment. After carrying out the entire series of treatments, both classes were given a posttest to see an increase in students' mathematical literacy skills.

This research was conducted at SMP Negeri 1 Punggelan, Banjarnegara Regency in January 2023. The population is a generalization area which includes subjects or objects that have certain qualities and characteristics which will be studied further and conclusions sought by researchers. The population in this study were students of class VIII SMP Negeri 1 Punggelan which consisted of 9 classes with 255 students. The sample is part of the number and characteristics of the population (Yani Fitriyani, et al., 2021). In this study, the sampling technique used simple random sampling technique. This is because the sampling is done randomly or lottery and does not pay attention to the strata in the population. Of the nine classes in SMP Negeri 1 Punggelan, the researchers took two classes to be used as samples, namely class VIII G as an experimental class with a total of 29 students and VIII H as a control class with a total of 29 students.

Methods of data collection in this study using interviews and tests. This interview was conducted with mathematics teachers at SMP Negeri 1 Punggelan regarding the learning process and the level of mathematical literacy ability of class VIII students. While the test is used to measure the level of mathematical literacy ability. The test is carried out using essay test questions that have been adapted to indicators of mathematical literacy ability. The aim is

to measure the level of students' mathematical literacy abilities and obtain data about the mathematical literacy abilities of class VIII students of SMP N 1 Punggelan. This test was carried out twice, namely before receiving treatment (pretest) and after receiving treatment (posttest) in class VIII G and VIII H of SMP N 1 Punggelan. Before being used for research, the research instrument was validated using construct validity and content validity by experts. In addition, the research instrument was also tested for validity using the Pearson product moment correlation test. In addition, a reliability test was also carried out to measure the consistency of respondents' answers in answering the questions in the test.

To analyze the research data, researchers used the t test and the N-Gain test. The t-test was conducted to determine whether there was a difference in the average literacy skills of class VIII students of SMP N 1 Punggelan so as to determine whether the GI-type cooperative learning model assisted by comic media had a significant effect on students' mathematical literacy abilities. The formulation of the hypothesis is:

$H_0 : \mu_1 = \mu_2$

$H_1 : \mu_1 \neq \mu_2$

Information:

μ_1 : The average value of students' mathematical literacy skills subjected to the GI type cooperative learning model assisted by comic media

μ_2 : The average value of students' mathematical literacy skills who were not subjected to the GI type cooperative learning model assisted by comic media

The basis for decision making in the t test with a significant level of 5% or 0.05 is as follows (Rahma & Dharma, 2017):

If the probability value ≥ 0.05 then H_0 is accepted and H_1 is rejected

If the probability value < 0.05 then H_0 is rejected and $H_1$is accepted

The N-Gain test was carried out with the aim of knowing the effectiveness of the GI type cooperative learning model assisted by comic media to increase the average mathematical literacy ability of class VIII students of SMP N 1 Punggelan. To find out whether the acquisition of an effective score or not in this study, the interpretation of the percentage of effectiveness for the average N-Gain Meltzer model (Rahma & Dharma, 2017):

Table 1. N-Gain Interpretation

Percentage (%)	Interpretation
N-Gain ≤ 40%	Ineffective
41% < N-Gain ≤ 55%	Less Effective
56% < N-Gain ≤75%	Effective Enough
N-Gain ≥ 76%	Effective

C. Results and Discussion

1. Results

a. Validity Test

In this study, test the validity of the instrument using construct validity and content validity. Construct validity is used to measure whether the research instrument contains the concept of the material used as the basis for preparing the instrument. Construct validity uses the opinion of an expert, namely Mr. Heru Agni Setiaji, M.Pd.

Where the instrument has been declared feasible to be tested or valid after several improvements have been made. Content validity is done by comparing the research instruments with the subject matter being taught. In this study, content validity was carried out by Mrs. Yuli Winarni, S.Pd as a mathematics teacher at SMP Negeri 1 Punggelan. The instrument was declared valid because it was in accordance with the material taught in class VIII, namely the Pythagorean theorem material.

In addition to testing the validity by the experts, the researchers also tested the mathematical literacy ability instrument by giving test questions to class IX students, totaling 26 respondents. From the results of the validity test of the mathematical literacy ability instrument that was carried out with the help of the Microsoft Excel application and SPSS version 23 with 26 respondents and a significant level of 5%, the researcher obtained the following data:

Table 2. Validity Test Results of Mathematical Literacy Ability Instruments

No	r_{count}	r_{table}	Information	Validity Interpretation
1	0,536	0,388	Valid	Good Enough
2	0,473	0,388	Valid	Good Enough
3	0,556	0,388	Valid	Good Enough
4	0,226	0,388	Invalid	Not Good
5	0,419	0,388	Valid	Good Enough
6	0,339	0,388	Invalid	Not Good
7	0,501	0,388	Valid	Good Enough

From the table it can be concluded that there are 5 valid instruments, namely test questions number 1,2,3,5 and 7 so that they can be used in research.

b. Reliability Test

After testing the validity, the research instrument was also tested for reliability with the help of the SPSS version 23 application, the following results were obtained:

Table 3. Reliability Test Results

Reliability Statistics	
Cronbach's Alpha	N of Items
.626	5

The results of the reliability test show that Cronbach's Alpha value on the mathematical literacy ability test is 0.626 > 0.60, so it can be interpreted that the test questions have a fairly good consistency of the respondents' answers.

c. Normality Test

The normality test is a test used to determine whether the data is normally distributed or not. The data normality test uses the Kolmogorov-Smirnov method where assuming $H_1$is accepted and H_0 is rejected. The data criterion is said to be normal if the significant number is the Kolmogorov-Smirnov Sig test. ≥ 0.05. The following table shows the results of testing the data using the SPSS version 23 application

Table 4. Normality Test Results

Tests of Normality

Kelas	Kolmogorov-Smirnov[a]	Shapiro-Wilk

		Statistic	Df	Sig.	Statistic	df	Sig.
NGain	Kelas Eksperimen	.112	29	.200*	.949	29	.172
	Kelas Kontrol	.141	29	.145	.945	29	.137

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the results of the normality test, it appears that the significant value of the Kolmogorov-Smirnov test on the N-Gain score of the experimental class is 0.200 and that of the control class is 0.145. This means $H_1$is rejected and H_0 is accepted. With the conclusion that both classes have a significant value of 0.200 > 0.05 and 0.145 > 0.05 so that the data is normally distributed.

d. Homogeneity Test

Homogeneity testing was carried out aiming to find out whether the experimental class and control class came from a number of homogeneous populations or not. The data criterion is said to be homogeneous if the significant number of N-Gain data ≥ 0.05. The following table shows the homogeneity test results using the SPSS version 23 application:

Table 5. Homogeneity Test Results

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
NGain	Based on Mean	.809	1	56	.372
	Based on Median	.779	1	56	.381
	Based on Median and with adjusted df	.779	1	53.413	.381
	Based on trimmed mean	.826	1	56	.367

Based on the results of the homogeneity test, it appears that the significant value is 0.372 ≥ 0.05. This means that H_0 is accepted and H_1 is rejected, with the conclusion that the experimental class and the control class come from a homogeneous population.

e. T Test

The t test was used to determine whether there was a significant difference in the average mathematical literacy ability of class VIII students between classes that were subjected to the GI cooperative learning model assisted by comic media and those that were not subjected to it. In this t test using two independent samples t test. The criterion for the t test is that if the probability value (Sig.) ≤ 0.05 then there is an average difference. The following table results of the t test using the SPSS version 23 application:

Table 6. T test results

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means					
	F	Sig.	t	df	Sig. (2-	Mean Differe	Std. Error	95% Confidence Interval of the

						taile d)	nce	Differe nce	Difference	
									Lower	Upper
NGain	Equal variances assumed	.80 9	.372	11.5 62	56	.000	.30327	.02623	.25073	.35582
	Equal variances not assumed			11.5 62	54.53 3	.000	.30327	.02623	.25070	.35585

Based on the results of the t test, it can be seen that the value of Sig. (2-tailed) namely 0.000 <0.05, then H_0 is rejected and H_1 is accepted, meaning that the average mathematical literacy ability of students who are subjected to the GI-type cooperative learning model assisted by comic media is not the same as students who are not subjected to the GI-assisted cooperative learning model comic media.

f. N-Gain Test

1) N-Gain Test of Experimental Class Mathematical Literacy Ability

The magnitude of the increase in the mathematical literacy skills of the experimental class was calculated using the N-Gain formula with the help of the SPSS version 23 application. Statistical data on the value of N-Gain on the mathematical literacy abilities of the experimental class are presented in the following table:

Table 7. Statistical Data of Experimental Class N-Gain Values

The Number of Students	29
Highest Score	0,91
Lowest Score	0,60
Average Score	0,77

Based on the table, it can be seen that the average N-Gain value of students in the experimental class is 0.77, which means that there is an increase in mathematical literacy skills after getting learning with the GI type cooperative learning model assisted by comic media.

The table of criteria for obtaining the N-Gain value to find out the level of increase in mathematical literacy skills is as follows:

Table 8. Statistical Data of Experimental Class N-Gain Values

N-Gain Value	**Category**	**Frequency**	**Percentage (%)**
N-Gain $>$ 0,70	High	20	68,97%
0,30 $\leq$ N-Gain $\leq$ 0,70	Moderete	9	31,03%
N-Gain $<$ 0,30	Low	0	0%
N-Gain = 0	No Increase	0	0%
-1,00 $\leq$ *N-Gain*	Decrease Occurred	0	0%
Amount		29	100%

Based on the table, it can be seen that 20 students with a percentage of 68.97% scored in the high category and 9 students with a percentage of 31.03% scored in the medium category. Overall the average value of N-Gain in the experimental class is 0.77 which is included in the high category.

The following is a table of N-Gain interpretations in the experimental class to determine the effectiveness of a lesson to improve mathematical literacy skills:

Table 9. Interpretation of Experimental Class Effectiveness

Percentage (%)	Interpretation	Frequency
N-Gain ≤ 40%	Ineffective	0
41% < N-Gain ≤ 55%	Less Effective	0
56% < N-Gain ≤75%	Effective Enough	14
N-Gain ≥ 76%	Effective	15

From the table, it is known that the experimental class is quite effective for 14 students, and effective for 15 students. On the average percentage value obtained by the experimental class, namely 77%, it can be interpreted that the results are effective. Therefore, it can be concluded that learning using the GI type cooperative learning model assisted by comic media in the experimental class is effective for increasing the mathematical literacy skills of class VIII students.

2) N-Gain Test of Control Class Mathematical Literacy Ability

The increase in the mathematical literacy ability of the control class was calculated using the N-Gain formula with the help of the SPSS version 23 application. Statistical data on the value of N-Gain in the mathematical literacy ability of the control class is presented in the following table:

Table 10. Statistical data for control class N-gain values

The Number of Students	29
Highest Score	0,64
Lowest Score	0,27
Average Score	0,47

Based on the table, it can be seen that the average N-Gain value of students in the control class is 0.47, which means that there is an increase in mathematical literacy skills after getting learning with conventional learning models and not using media.

The table of criteria for obtaining the N-Gain value to find out the level of increase in mathematical literacy skills is as follows:

Table 11. Criteria for Obtaining Control Class N-Gain Values

N-Gain Value	Category	Frequency	Percentage (%)
N-Gain > 0,70	High	0	0%
0,30 ≤ N-Gain ≤ 0,70	Moderete	27	93,1%
N-Gain < 0,30	Low	2	6,9%
N-Gain = 0	No Increase	0	0%
-1,00 ≤ *N-Gain*	Decrease Occurred	0	0%
Amount		29	100%

Based on the table, it can be seen that 27 students with a percentage of 93.1% got scores in the medium category and 2 students with a percentage of 6.9% got scores in the low category. Overall the average value of N-Gain in the control class is 0.47 which is included in the medium category.

The following is a table of N-Gain interpretations in the control class to determine the effectiveness of a lesson to improve mathematical literacy skills:

Table 12. Interpretation of Control Class Effectiveness

Percentage (%)	Interpretation	Frequency
N-Gain ≤ 40%	Ineffective	8
41% < N-Gain ≤ 55%	Less Effective	13
56% < N-Gain ≤75%	Effective Enough	8
N-Gain ≥ 76%	Effective	0

From the table, it is known that the control class was not effective for 8 students, less effective for 13 students, and quite effective for 8 students. On the average percentage value obtained by the control class, namely 47%, it can be interpreted that the results are less effective. Therefore, it can be concluded that learning that does not use the GI type cooperative learning model assisted by comic media in the control class is less effective in increasing the mathematical literacy skills of class VIII students.

2. Discussion

Based on the first hypothesis test to see the increase in students' mathematical literacy abilities before and after being given treatment, the N-Gain test was carried out for the experimental class and the control class. The experimental class obtained an average N-Gain value of 0.77 with high criteria, while in the control class the average N-Gain value for the control class was 0.47 with moderate criteria. This is also in accordance with the results of the independent sample t test output test (t-test) using SPSS version 23, showing the value of Sig. of 0.000 < 0.05. These results indicate that the mathematical literacy skills of the students in the experimental class and the control class are significantly different due to different treatments in the two classes.

So it can be concluded that in experimental research conducted by applying the GI type cooperative learning model assisted by comic media, the average mathematical literacy ability of class VIII students who were subjected to the GI type cooperative learning model assisted by comic media was better than the average student who was not subjected to the comic media type GI cooperative learning model. GI type cooperative learning model assisted by comic media.

This is in line with the statement from Fauzi (2019), that group investigation is a type of cooperative learning model that emphasizes the activeness of students in seeking information and solving problems regarding learning material in groups to increase students' understanding and critical thinking skills regarding subject matter so that it will improve students' mathematical literacy. According to Trianto, the third step in GI cooperative learning is implementation or investigation. At this stage, students collect information on subject matter from various sources, one of which is learning media. One of the learning media that can support learning mathematics to improve mathematical literacy is the media of mathematical comics. Rosyida (2018) stated that reading comics can foster a critical attitude in children, stimulate interest in reading, provide direction to students who do not like to read so that they are disciplined in reading, and make it easier for students to capture the message or material presented. According to Gafoor (2013), math comic media has an interesting and easy-to-understand storyline. From its distinctive design so that it has great power to convey information that can stimulate student activity and creativity so that it will improve mathematical literacy abilities.

The results of Nia Kurniati's research stated that the average increase in the ability of mathematical literacy of students whose learning used cooperative learning models was higher than the increase in the ability of mathematical literacy of students whose learning used conventional learning models. (Kurniati, 2020). The results of Tarmizi Akbar's research (2021) also stated that the use of the group investigation type cooperative learning model to improve students' mathematical literacy skills obtained an average N-Gain value of 0.32 with moderate criteria. Then it is compared using the t test of two independent samples to produce a significant value of 0.002 which is less than a significant level of 0.05, then $H_0$is rejected and H_1 is accepted.

To find out the level of effectiveness of the learning model carried out in the experimental class and the control class, it is done using the interpretation of the N-Gain test. In the experimental class, learning uses the GI type cooperative learning model assisted by comic media. Whereas in the control class, the learning did not use the GI cooperative learning model assisted by comic media. The results of the N-Gain test in the experimental class showed an average N-Gain value of 77% included in the effective criteria, while in the control class it showed an average N-Gain value of 47% included in the less effective criteria.

This is in line with the results of Fitri Isnaini's research (2020) which used the GI type cooperative learning model to increase students' understanding of mathematical concepts. In the experimental class, the average N-Gain value was 72% with high criteria (effective) and the control class was 38%. with moderate criteria (less effective). The results of Rosmita Sari Siregar's research (2022) also stated that learning through the group investigation model was effective in increasing numeracy literacy skills in mathematics subject on flat shape material in fifth grade elementary school students. Nailul Himmi Hasibuan (2022) in his research also states that codular-based comic learning media can increase the value of student learning outcomes by up to 62% and is effective for increasing mathematical literacy skills.

Therefore it can be concluded that the GI cooperative learning model assisted by comic media is effective for increasing the mathematical literacy skills of class VIII students of SMP Negeri 1 Punggelan.

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The Effect of Mathematical Disposition on Students' Mathematical Creative Thinking Abilities in Class XI

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Abstract: Mathematics is a lesson that is useful for the development of thinking. Then, thinking becomes an important process in it, where students are expected to be able to think deductively. Students are asked to understand the concept of the material that has been delivered with an active and conscious attitude, referred to as a disposition. The purpose of this research was to find out the effectiveness of mathematical disposition on students' mathematical creative thinking abilities in the eleventh grade of MIPA MAN 2 Banyumas. The population in this research were all students of XI MIPA consisting of 243 students, 153 students were taken as samples using a simple random sampling technique. This research was conducted using quantitative research methods where data was obtained by distributing research instruments in the form of questionnaires and tests. The analysis technique used a simple linear regression analysis technique. Before the analysis test was carried out, the data went through analysis prerequisite tests, namely the normality test, regression significance test, and linearity test. The results of this study indicated that there was an influence of mathematical disposition on students' mathematical creative thinking abilities of 12,6%. When the regression equation was obtained, $\hat{Y}=8.325+0.730X$ showed that the regression coefficient value was positive. Therefore, if the mathematical disposition (X) was increased by 1 unit, the student's mathematical creative thinking ability (Y) could be increased by 0.730 units.

Keywords: Creative Thinking; Disposition; Mathematical Abilities; Mathematical Dispostion; Mathematics.

A. Introduction

In simple terms, education is defined as an effort made by humans to foster human personality so that it can be in accordance with the values in society and culture. According to J.J. Rousseau, education is to give us provision that does not exist in childhood, but we need it in adulthood. The educational process that we know is a process of interaction that involves at least two people, namely between students and teachers. This is in line with Macmud's opinion which says that the educational process is carried out by educators who are conscious, intentional, and full of responsibility in guiding students to become physically and spiritually mature as well as socially mature. So that in the future they can become human beings who are able to carry out physical tasks as well as think, behave, have an adult will, and can live normally and have the courage to be responsible for their attitudes and actions towards others.

The process of interaction carried out between the teacher and students is referred to as the teaching and learning process. Teaching as an activity to create an environment that allows the learning process to occur. Self-study is a process carried out by someone to be able to produce changes in behavior that are carried out intentionally in order to gain knowledge, skills, and new experiences in a better direction. As we know, in the world of education, so many learning materials are delivered by teachers to students, especially in our beloved country. Such as Indonesian, Physics, Religious Education, Arts, Sociology, Mathematics, and many more.

Mathematics as a subject that is considered difficult by most students because mathematics is abstract, logical, systematic, and full of confusing symbols and formulas. However, mathematics actually has an important role in various scientific disciplines and promotes human thought. One reason is because mathematics is a science that can cover all aspects of life and education. It can be said that mathematics is also a subject that is closely related to everyday life. Parts of mathematics such as calculating, measuring, processing data, and others play a role in the process of forming something new, whether in science, problem solving, development, or technology. Through learning mathematics it is hoped that it can make students flexible in explaining the interrelationships between mathematical concepts, explaining mathematical ideas and statements, interpreting the solutions obtained, communicating ideas with symbols, tables, diagrams, or other media to clarify problems. This ability is an aspect of the ability to think creatively mathematically. Mathematics as a lesson that is useful for the development of thoughts such as ideas, processes, and reasoning related to opinions or facts. In learning mathematics, thinking becomes an important process in it, where students are expected to be able to think deductively. However, in reality, there are still many students whose abilities are still low. For example, they still have difficulties in performing mathematical calculations and operations, and they are even still fixated on the examples given. When they are given different types of questions with examples, they will face difficulties.

Creative thinking is a learning process that is carried out with several methods and various strategies to be able to provide motivation and bring out students' creativity during learning. Creative thinking is the ability to provide various possible answers or problem solving based on the information provided, and being able to generate many ideas related to a problem. This creative thinking ability provides opportunities for students to be creative and imaginative in solving a mathematical problem. With trained creative thinking skills, the ability to relate students' mathematical ideas is formed, then their mathematical understanding skills will be better, students can also understand the relationships between topics in mathematics. Creative thinking in mathematics is the ability to understand patterns and relationships using complex thinking. According to Tall in La Moma, creative thinking is thinking in an effort to solve problems and/or develop thinking in structures by paying attention to the rules of deductive reasoning and generating relationships from concepts to unify important points in mathematics. Thinking creatively in learning mathematics can make it easier for students to solve math problems, because students can express answers to problems with various solutions. Mathematical creative thinking has several indicators, according to Munandar there are four indicator components, namely: Fluency, providing many answers, ideas, and problem solving. Flexibility, generate various ideas or answers.

Originality, creating unique ideas or original ideas. Elaboration, adding or detailing the details of an object, idea, or situation so that it becomes more interesting.

In the learning process, students are asked to understand the concept of the material that has been delivered with an active and conscious attitude, or referred to as a disposition. When students are learning mathematics, student behavior tends to be conscious, organized, and voluntary to build traits, attitudes, and skills in mathematics, this is explicitly called the students' mathematical disposition. Sumarmo defines a mathematical disposition as a strong desire, awareness, inclination, and dedication for students to think and act mathematically. Kilpatrick defines a mathematical disposition as a productive disposition, or a view of mathematics as being logical and producing something useful. Mathematical disposition is an awareness that exists in students to be able to play an active role in the learning process. Where students play an active role in class such as asking if the material that has been delivered by the teacher is not well understood. Mathematical disposition can also be interpreted as students' interest and appreciation of mathematics, in the form of a tendency to think and act positively, including self-confidence, curiosity, perseverance, enthusiasm for learning, persistent in facing problems, flexible, willing to share with others, and reflective in math activities.

In learning, teachers should be able to cultivate a conscious, organized, and voluntary disposition in students for the implementation of good learning. Disposition plays an important role in supporting the proper course of learning mathematics, so that students can enjoy learning mathematics, experience the benefits, and can apply mathematics in everyday life. Polking states that the existence of a mathematical disposition can be demonstrated by the existence; confidence in using mathematics, solving problems, giving reasons, and communicating ideas; flexibility in investigating mathematical ideas and trying to find alternative methods in solving problems; diligently doing math assignments; interest, curiosity, and inventiveness in solving mathematical tasks; tend to monitor, reflect on their own performance and reasoning; assess the application of mathematics to other situations in mathematics and everyday experience; and appreciate the role of mathematics. According to the NCTM (National Council of Teachers Mathematics), there are seven indicators of mathematical disposition, namely; confidence in solving math problems, communicating ideas, and giving reasons; flexibility in exploring mathematical ideas and trying various alternative methods to solve problems; strong determination to complete math tasks; interest, curiosity, and the ability to discover in doing mathematics; tendency to monitor and reflect on one's own thought processes and performance; assess the application of mathematics in other fields in everyday life; and appreciate the role of mathematics in culture and its values, both mathematics as a tool, and mathematics as a language. The benefits of this disposition include, the transfer of knowledge to students can run as expected, the atmosphere in the learning process becomes more enjoyable so that it will provide maximum results, and the teacher will be more enthusiastic about teaching in class.

Based on the results of an interview that was conducted with Ms. Devi Rakhmawaty, a Class XI math teacher at MAN 2 Banyumas, on Thursday, November 17 2022, said that in learning mathematics the teacher gives students the opportunity to learn from various references, with the hope that students can develop their way of thinking, especially how to think creatively in solving mathematical problems with various alternative solutions. But in

fact there are still some obstacles, such as the habit of students writing answers to questions the same as the examples given by the teacher. This can be an obstacle for students in developing mathematical creative thinking processes, there are even some students who don't want to do the practice questions given from the teacher.

Based on this explanation, students' ability to think creatively cannot be maximized. This is in line with the results of Suparman and Zanthy's research which shows that the low ability to think creatively mathematically is because there are still students' mistakes in solving mathematical creative thinking ability questions in the process of making mathematical models, identifying the adequacy of elements and concepts contained, as well as errors in arithmetic operations. The ability to think creatively mathematically is important because by understanding the flow of thinking in solving mathematical problems, it will be easier for students to determine the best way to solve the problem, or in other words students can answer questions with not only one way of solving. In addition to the ability to think creatively mathematically, In learning mathematics, students can also develop other abilities, such as being critical and careful, objective and open, appreciating the beauty of mathematics, curiosity, thinking and acting creatively, and enjoying learning mathematics. These attitudes and thinking habits will shape students' mathematical dispositions. Mathematical disposition is a strong desire, awareness and dedication in students to learn mathematics and carry out various mathematical activities. From this explanation, there is a relationship between mathematical creative thinking abilities and mathematical dispositions such as the results of Reynaldi, Sugiatno, and Astuti's research which shows a relationship between mathematical creative thinking ability and mathematical disposition. Where students who have a high mathematical disposition will also have good creative thinking abilities. In addition, in developing the level of creative thinking, students need a mathematical disposition at each level of creative thinking experienced by students. It is hoped that in each learning process with the aim of developing students' creative thinking levels, accompanied by strong awareness and dedication within students.

From the results of the observations and explanations that have been presented, the researcher is interested in examining more deeply related to “the Effect of Mathematical Disposition on Students' Mathematical Creative Thinking Abilities in Class XI”. Referring to the formulation of the problem that has been described, the purpose of this study is to find out whether there is an influence of mathematical disposition on the mathematical creative thinking abilities of class XI MIPA MAN 2 Banyumas.

B. Methods

The type of research used in this study is a quantitative research method. Quantitative research is a research method that is based on the philosophy of positivism, where this method is used in researching a population or sample. Data are obtained with research instruments and analyzed using quantitative/statistical methods, and aim to test hypotheses that have been set before. This research also belongs to causative research which is a type of research with problem characteristics in the form of a causal relationship between two or more variables. Based on the formulation of the research problem, there are two variables used, namely the independent variable and the dependent variable. the independent variable

in this study is the mathematical disposition while the dependent variable is the mathematical creative thinking ability. Data collection was carried out by distributing questionnaires related to mathematical disposition and tests of mathematical creative thinking skills to students of class XI MIPA MAN 2 Banyumas. The data collection process starts from content validity and item validity. Content validity is the validity that is tested through testing the feasibility of the content through rational analysis by a competent panel or through expert judgment. While item validity is used to determine the validity/accuracy/accuracy of the question items in measuring the variables studied. The validity test that the researcher will use is the Product Moment Correlation developed by Pearson in testing the validity of the items. Research data collection was carried out in the even semester of the 2022/2023 school year, in the period from May 26 to June 10, 2023. The data obtained was then analyzed with prerequisite tests, namely normality tests, regression significance, and linearity tests which had previously been tested for validity and reliability. Then a hypothesis test was carried out to obtain research results related to students' mathematical dispositions and creative thinking abilities.

C. Results and Discussion

1. Result

Data processing as a whole is assisted by the SPSS Version 25.0 application. Before the data collection process is carried out, the mathematical disposition questionnaire instrument and the mathematical creative thinking ability test will go through validity and reliability tests first. The questionnaire instrument was compiled based on indicators of mathematical disposition with a total of 27 statement items, while the test instrument was compiled based on indicators of the mathematical creative thinking ability with 6 points of items. From the results of validity and reliability testing, obtained 20 questionnaire instruments and 5 points of item test instruments which were declared valid. This instrument will be used in the process of collecting data in research. After the data related to mathematical disposition and mathematical creative thinking ability is obtained, then an analysis prerequisite test is carried out.

The first step is to do a normality test. The normality test is used to prove whether a sample from a population is normally distributed, it can also be used to prove that the population has a normal distribution. This normality test is carried out by comparing the data owned with distribution data that has the same mean and standard deviation. Data that is normally distributed is a requirement of parametric statistics. Based on the results of data processing that has been done, the results show that the data is normally distributed. This is based on the results of the Kolmogorov-Smirnov test, the results of the analysis obtained a significance value of 0.54 greater than 0.05, it can be concluded that the data is normally distributed. The results of this normality test are based on the results of the following table analysis:

Table 1.Normality Test Result

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.

Unstandardized Residual	,072	153	,054	,976	153	,008

a. Lilliefors Significance Correction

Then a linearity test was carried out between mathematical dispositions and mathematical creative thinking abilities. The linearity test was conducted to determine the relationship between the independent variables and the dependent variable whether it was linear or not, or whether it could be interpreted as a straight line or not. This linearity test uses decision-making criteria if the value of Sig. ≥ 0.05 indicates that the relationship between the research variables is linear. Otherwise, if the significance value < 0.05 indicates that the relationship between research variables is not linear. The following table shows the results of the data linearity test:

Table 2. Linearity Test Results

			Sum of Squares	df	Mean Square	F	Sig.
Creativ * Disposition	Between Groups	(Combined)	10317,749	32	322,430	1,796	,013
		Linearity	4008,975	1	4008,975	22,337	,000
		Deviation from Linearity	6308,773	31	203,509	1,134	,308
	Within Groups		21537,480	120	179,479		
	Total		31855,229	152			

From Table 2 it is found that there is a linear relationship between mathematical disposition and the mathematical creative thinking ability. This is indicated by the significance value of the Deviation from Linearity, which is 0.308, which is greater than the value of 0.05.

Next, a regression significance test was carried out to see how much influence mathematical disposition had on students' mathematical creative thinking abilities with the test results presented as follows:

Table 3. Regression Significance Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4008,975	1	4008,975	21,739	,000[b]
	Residual	27846,253	151	184,412		
	Total	31855,229	152			

a. Dependent Variable: Kreatif

b. Predictors: (Constant), Disposisi

Based on Table 3, the value of significance is 0.000. So it can be concluded that Sig. 0.000 < 0.05 means that the regression is significant. So that the mathematical disposition

variable can be used to determine students' mathematical creative thinking abilities. Then will look for the value of the coefficient of determination. where the coefficient of this determinant shows the extent to which the contribution of the independent variables in the linear regression model is able to explain the variation of the dependent variable. The coefficient of this determinant can be seen from the table, namely the value of R-Square (R^2). The R-Square value can be obtained from the following table:

Table 4. Output R-Square Value

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,355[a]	,126	,120	13,580

a. Predictors: (Constant), Disposisi

b. Dependent Variable: Kreatif

The table above shows the magnitude of the correlation value which is equal to 0.355 and shows the large percentage of influence of the independent variable on the dependent variable which is referred to as the determinant coefficient as a result of squaring R. From the table the determinant coefficient value of 0.126 is obtained, which means that the magnitude of the influence of the mathematical disposition variable on mathematical creative thinking ability is 12.6%.

Table 5. Hypothesis Test Results

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	8,325	8,456		,985	,326
	Disposisi	,730	,156	,355	4,663	,000

a. Dependent Variable: Kreatif

Based on the results of the hypothesis test table above, the regression equation obtained from this research is:

$$\hat{Y} = 8{,}325 + 0{,}730X$$

The results of the regression equation show that if the students' mathematical disposition is zero, then the value of students' mathematical creative thinking ability is 8.325. The value of the regression coefficient is positive, which means that if the mathematical disposition (X) increases by 1 unit, the student's mathematical creative thinking ability (Y) will increase by 0.730 units. This shows that the students' mathematical disposition and creative thinking ability are directly proportional, in other words, the higher the student's mathematical disposition, the higher the student's ability to think creatively.

2. Discussion

In the discussion will be explained related to the results of research that has been conducted by researchers. This research was conducted to determine the effect of mathematical disposition on the students' mathematical creative thinking abilities in class XI MIPA MAN 2 Banyumas. The population used in this study were all students of class XI MIPA MAN 2 Banyumas totaling 243 students, with a sample of 153 students based on Simple Random Sampling or Probability Sampling technique calculations and utilizing the Research Randomizer website.

To obtain the required data, the researcher used a questionnaire instrument to obtain mathematical disposition data and tests for mathematical creative thinking skills. Disposition questionnaires and test questions were distributed to class XI MIPA students who had previously carried out content validity and item validity. Content validity is carried out to determine the feasibility of the content through rational analysis by a competent panel or through expert judgment. Item validity is carried out to obtain valid or invalid results related to each item and statement.

The reliability test results of the mathematical disposition questionnaire instrument were 0.745 and the students' mathematical creative thinking ability test instrument was 0.714. Decision making is by comparing the value of Cronbach's Alpha reliability with 0.6. If the reliability Cronbach's Alpha value is > 0.6, then the instrument is declared reliable. Otherwise, the instrument is declared unreliable. The results obtained from the reliability of the mathematical disposition questionnaire trial and the test questions related to the ability to think creatively mathematically with a total of 42 students with a significance level of 5% were declared reliable. So that this research instrument can be used as a data collection tool in the research that will be carried out.

The mathematical disposition questionnaire instruments and mathematical creative thinking ability tests that have been declared valid and reliable, are then distributed to students who are used as research samples. After the data has been obtained, then the prerequisite test and hypothesis test are carried out. From the results of the research that the researchers have done, the results show that there is an influence between mathematical dispositions on students' mathematical creative thinking abilities. These results were obtained from the results of a simple linear regression test which showed a significance level of 0.000. The value of $0.000 < 0.05$ so that H_0 is rejected and H_1 is accepted, which means that there is an influence of mathematical disposition on the students' mathematical creative thinking abilities in class XI MIPA MAN 2 Banyumas.

The regression equation obtained from this study is $\hat{Y}=8.325+0.730X$. The results of the regression equation show that the value of b is positive, which means that if the mathematical disposition (X) increases by 1 unit, the students' mathematical creative thinking ability (Y) will increase by 0.730 units. To find out the influence of students' mathematical dispositions on students' mathematical creative thinking abilities, it can be seen through the value of the R-Square determinant coefficient of 0.126. Where mathematical disposition influences students' mathematical creative thinking ability by 12.6% and 87.4% is influenced by other variables outside the mathematical disposition variable.

The results of this study indicate that there is an influence of mathematical disposition on students' mathematical creative thinking abilities. This is in line with the results of research by Reynaldi et al. which shows a relationship between mathematical creative

thinking abilities and mathematical dispositions where students who have high mathematical dispositions will have good creative thinking abilities. Suparman and Zanthy also suggested that there is a relationship between mathematical creative thinking ability and mathematical disposition.

This mathematical disposition is able to help students view mathematics positively. This positive attitude will make students like mathematics so they will be more assiduous, persistent and confident. This good disposition will enable students to be able to come up with creative ideas in the process of solving mathematical problems or creating new innovations. The existence of an association between mathematical dispositions and mathematical creative thinking abilities was demonstrated by Sugilar, where the results of his research showed that the association between students' mathematical creative thinking abilities and dispositions was relatively high.

This research obtained results in the form of a positive influence of mathematical disposition on students' mathematical creative thinking abilities. So that students are able to do mathematical tasks well, a mathematical disposition is necessary which will later provide encouragement to students to participate in the entire learning process, never give up, take responsibility for each task, and continue trying to find solutions to solve problems. With this, students' creative mathematical thinking abilities will be improved so that they can achieve maximum results. Based on these reasons, it is important to train and improve students' mathematical dispositions so that students can have good mathematical creative thinking skills.

From the results of this study, it will be explained regarding the description of the data based on the category table that has been compiled based on the calculation of the mean and the standard deviation obtained by the students score.

Table 6. Category Calculation Formula

Category	Formula
Low	$X \leq \text{mean} - \text{std. deviation}$
	$X \leq 53{,}58 - 7{,}039$
	$X \leq 46{,}541$
Medium	$\text{mean} - \text{std. deviation} < X \leq \text{mean} + \text{std. deviation}$
	$53{,}58 - 7{,}039 < X \leq 53{,}58 + 7{,}039$
	$46{,}541 < X \leq 60{,}619$
Hight	$X > \text{mean} + \text{std. deviation}$
	$X > 53{,}58 + 7{,}039$
	$X > 60{,}619$

Data on students' mathematical dispositions obtained by distributing questionnaires related to mathematical dispositions, the maximum score given for each statement item is 4 and the minimum score is 1.

Table 7. Category Results Instrument Mathematical Disposition Questionnaire

No.	Category	Frequency
1.	Low	19
2.	Medium	106
3.	Height	28
	Total	153

Based on the Table 7, the results obtained, from the 153 students who were used as research samples, there were 19 students who had a low level of mathematical disposition, 106 students had a medium level of mathematical disposition, and 28 students had a high level of mathematical disposition.

Then a table of categories of mathematical creative thinking ability will be made, with the highest score being 4 and the lowest score is 0 for each question.

Table 8. Category Results Instrument Mathematical Creative Thinking Ability Test

No.	Category	Frequency
1.	Low	29
2.	Medium	96
3.	Height	28
	Total	153

Based on the Table 8, from the 153 students sampled in the research, there were 29 students who had a low level of mathematical creative thinking ability, 96 students had a medium level of mathematical creative thinking ability, and 28 students who had high mathematical creative thinking ability.

D. Conclusion

Based on the results of the analysis and discussion of the research that the researchers have done regarding the effect of mathematical disposition on the students' mathematical creative thinking abilities in class XI MIPA MAN 2 Banyumas, it can be concluded that there is an influence of mathematical disposition on the students' mathematical creative thinking abilities in class XI MIPA MAN 2 Banyumas. The magnitude of the influence of mathematical disposition on the students' mathematical creative thinking abilities is 12.6% and the remaining 87.4% is influenced by variables other than mathematical disposition.

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