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Table of Content

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Comparison of Effect Size Independent and Disciplined Character on Students' Mathematics Success in Elementary Schools

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Abstract

Character values are very important to be instilled in elementary school students. There have been many studies that reveal the value of independent character and discipline related to the success of students' mathematics learning, so this study aims to compare the effect size of the value of independent and disciplined character on the success of learning mathematics at the elementary school level. Types of meta-analysis research. A total of 18 artifacts that were used as data were obtained through a Google Scholar search using predetermined keywords. Data analysis using the help of JASP 0.14.1.0 application. The results of the study obtained an effect size of independent character values (0.43) with a moderate effect category. Effect size discipline character value (0.69) with sufficient effect category. The effect size of the discipline character value is greater than the independent character value. The results of this study have shown that the value of the character of discipline at the elementary school level is more developed and entrenched than the value of independent character. These two character values have a positive and significant relationship in increasing students' success in learning mathematics at the elementary school level.

Keywords: *character values, independent, disciplined, successful in learning mathematics, effect size*

A. Introduction

Trends in the International Mathematics and Science Survey (TIMSS) and the International Student Achievement Mathematics Program (PISA) aim to provide information on student performance in mathematics. Both PISA and TIMSS assess students' achievement levels in Mathematics and Science (Wu, 2009). Students' mathematical performance emphasizes analyzing, reasoning, and communicating ideas (OECD, 2009)

Indonesia's PISA lesson scores in 2018 showed a decline in science, reading and math. In the field of mathematics, in 2015 it scored 386 while in 2018 it scored 379 (Figure 1). The decline that occurred in mathematics scores was influenced by many factors. One of the factors in students or internal factors. The internal factor in question is the attitude/character of students in learning mathematics. The better the attitude of students in learning mathematics, the students have a good character in learning mathematics. Based on the research results of Khadijah et al., (2021) that the value of character education in schools has an impact on the success of students' mathematics learning. The research of Harun et al., (2021) that students' attitudes have an impact on the success of learning mathematics. Student attitude variables are very important in the success of learning mathematics (Diggs & Akos, 2016). Learning outcomes and student achievement in learning mathematics are influenced by the attitudes or character of the students themselves.

Figure 1. Comparison of PISA Scores 2012, 2015, and 2018
(Source: Fadhillah in https://indonesiapisa.com/profile/)

Once the importance of character values, so strengthening character education needs to be implemented at the elementary school level. Students at the elementary school level have good character strengths, must be able to implement the character values they have in everyday life (Putri et al., 2020). Trustworthiness, fairness, respect, caring, responsibility, and civic duty-citizenship are universal character values that can be instilled and developed in elementary school students (Zamroni, 2011). There are five national character values in the character education strengthening program, namely independent, nationalist, mutual cooperation, integrity, and religious (Setiawan et al., 2021). From the research results Aningsih et al., (2022). Finding that the values of character education implemented in elementary schools include discipline, religion, leadership, responsibility, cooperation, love, tolerance, neatness, cleanliness, courtesy, perseverance, self-confidence, courage, economy, independence, diversity of acceptance, honesty, nationalism , creativity, achievement award and fairness. Many character values are instilled in elementary school students, the values of independent character and discipline are character

values that relate to oneself. These two values have had a good impact on the success of learning mathematics.

The value of independent character and discipline can be used as the strength of student character values in learning mathematics. There have been many research results that reveal the positive and significant impact of the value of independent character and discipline on student learning success in mathematics. Research by Rahmawati (2016), Egok (2016), Aliyah (2019), Susintoi et al., (2019), Muliyanti et al., (2020), Siagian et al., (2020), Larasati et al., (2020), Aglistya (2020), and Riyanti et al., (2021) that the value of independent character has a positive and significant impact on the success of students' mathematics learning. In addition, the value of the discipline character has a positive and significant impact on the success of learning mathematics. This statement is reinforced by the results of research by Pamungkas (2017), Rusni and Agustan (2018), Prihandir (2018), Fitria et al., (2018), Utama (2020), Naibaho et al., (2020), Fernandes (2021), and Novita & Akhsan (2022). The results of previous research on the value of independent and disciplined characters are only limited to revealing positive and significant relationships or impacts on learning outcomes or learning achievement in mathematics, but have not revealed the effect size. It is necessary to do a meta-analysis research, to reveal the effect size comparison of independent and disciplined character values on the success of learning mathematics at the elementary school level.

Meta-analytical research combines several or many studies and is statistically analyzed (Hedges, 1987). Meta-analysis is a statistical procedure that integrates the results of several studies (Egger et al.,1997). According to Crombie and Davies (2009) meta-analysis is one technique in statistics to combine several findings from independent studies. Meta-analysis is a statistical synthesis method by combining and analyzing quantitative results from many empirical studies (Glass, 1976). In the meta-analysis there is hypothesis testing using inferential statistics to draw conclusions about the overall results of the study (Cooper, 1989). Meta-analysis is encouraging to determine the extent to which the attributes of a combination of several studies support the hypothesis (Caird et al., 2008). Meta-analysis is a way to get the average from a combination of various studies and get a measure of effect size (Barendregt et al., 2013). Meta-analysis in this study is to collect the results of research on the relationship between independent character values and discipline with the success of students' mathematics learning at the elementary school level. The research has been published in the form of an article or thesis. Research results that have been published are called artifacts. The collected artifacts will be statistically analyzed.

B. Methodology

The type of research used is meta-analysis. The theory of meta-analysis refers to the opinion of Hedges (1987) by combining several or many studies (artifacts) about the value of independent character and discipline with learning outcomes or student achievement in mathematics in elementary schools. The artifacts were statistically analyzed.

Artifacts as research data were collected through searching the Google Scholar link. The Publish or Perish application is used to make it easier to search on Google Scholar links. Artifact search keywords are used to speed up the discovery of artifacts that match the intended variable. The keywords used in Indonesian are:

1. The value of independent character with elementary school students' mathematics learning outcomes
2. The value of independent character with mathematics learning achievement of elementary school students
3. The value of discipline character with elementary school students' mathematics learning outcomes
4. The value of discipline character with elementary school students' mathematics learning achievement

There are two variables in the study, namely the value of independent character and discipline as the first variable. Learning outcomes or mathematics learning achievement of elementary

school students as the second variable. Learning outcomes and learning achievement is called the success of learning mathematics. There are several criteria used in collecting artifacts containing these two variables, namely:

1. It's on the Google Scholar link or open access
2. Are the results of research in Indonesia
3. Presented in Indonesian
4. Published in the form of articles or thesis
5. Loading both research variables
6. Year of publication (2016 – 2022)
7. Have a value of F, t or r
8. Have sample size (N)

The collected artifacts are tabulated into an Excel file, using a coding approach. Coding is required in the meta analysis (Decoster, 2009). The coding procedure carried out is that the desired characteristics of the artifact are coded and write down the specific coding scheme such as correlation (r), value (t), value (F), and sample size (N), Effect Size (ES), and Standard Error (SE). The tabulated artifacts were statistically analyzed with the help of the JASP 0.14.1.0 application to obtain the effect size and summary effect size of the artifact. According to Cohen (2007) effect size and summary affect size are 0 - 0.20 (weak), 0.21 - 0.50 (fair), 0.51 - 1.00 (moderate), and > 1.00 (strong).

C. Findings and Discussion

1. Findings

Searching for artifacts on the Google Scholar link with the help of the Publish or Perish application, obtained 18 artifacts consisting of 9 artifacts related to independent character values, and 9 artifacts related to discipline character values. The artifacts obtained have met the specified criteria. Artifacts have been published in the form of articles and theses (Table 1 and Table 2).

Table 1. Artifact Characteristics of Independent Character Value

Author	Publication	Indexing	N	r	t	F	Characteristics
Muliyanti et al., (2020)	Journal	-	50	0.543	-	-	Class V Elementary School
Aglistya (2020)	Thesis	-	415	0.294	-	-	Class IV Elementary School
Aliyah (2019)	Thesis	-	410	-	2.695	-	Class V Elementary School
Rahmawati (2016)	Thesis	-	85	0.56	-	-	Class IV, V, VI Elementary School
Egok (2016)	Journal	-	315	0.405	-	-	Class V Elementary School
Susintoi et al., (2019)	Journal	-	84	0.409	-	-	Class III Elementary School
Larasati et al. (2020)	Journal	Sinta 4	266	0.452	-	-	Class IV Elementary School
Riyanti et al., (2021)	Journal	Sinta 4	431	0.395	-	-	Class IV Elementary School
Siagian et al., (2020)	Journal	Sinta 3	45	-	-2.029	-	Class V Elementary School

Artifacts of independent value character values come from articles published in journals (N=6) and thesis (N=3). There are articles published in reputable journals Sinta 3 and Sinta 4. Number of students for all artifacts (N=1255). Artifacts that have a correlation value (N=7) and which only have a t value (N=2), after the transformation process were obtained (t=2.965 and r=0.258) and (t=2.029 and r=0.296). Characteristics of students are in class III, IV and VI.

Table 2. Artifact Characteristics of Disciplinary Character Value

Author	Publication	Indexing	N	r	t	F	Characteristics
Naibaho et al., (2020)	Journal	Sinta 3	32	0.752	-	-	Class V Elementary School
Fitria et al., (2018)	Journal	Sinta 4	80	0.385	-	-	Class V Elementary School
Utama (2020)	Thesis	-	102	0.570	-	-	Class IV Elementary School
Novita & Akhsan (2022)	Journal	-	84	0.486	-	-	Class IV Elementary School
Rusni and Agustan (2018)	Journal	Sinta 4	36	0.799	-	-	Class IV, V, VI Elementary School
Fernandez et al., (2021)	Journal	-	30	0.608	-	-	Class IV Elementary School
Pamungkas (2017)	Thesis	-	19	0.995	-	-	Class IV Elementary School
Prihandir (2018)	Thesis	-	64	0.440	-	-	Class IV Elementary School
Fadila (2018)	Thesis	-	33	-	2.392	-	Class V Elementary School

The artefacts of character values of discipline come from articles published in journals (N=5) and thesis (N=4). There are articles published in reputable journals Sinta 3 and Sinta 4. Number of students for all artifacts (N=480). Artifacts that have a correlation value (N=8) and which only have a t value (N=1), after the transformation process were obtained (t=2.392 and r=0.395). Characteristics of students are in grades IV and VI.

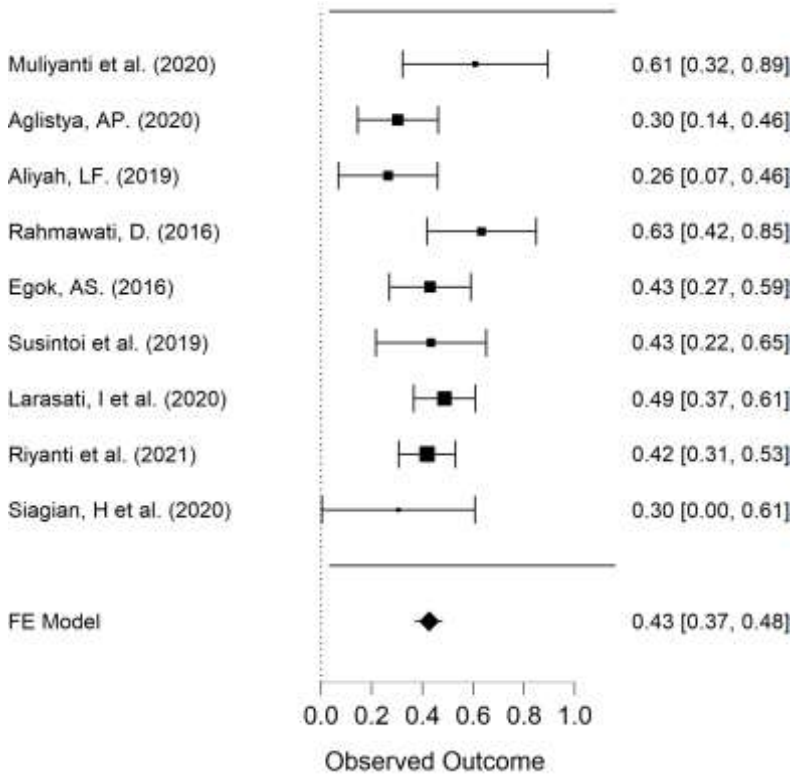

Figure 2. Effect Size and Summary Size of Independent Character Value

Based on data sourced from 18 artifacts, the effect size and summary effect size were calculated. Calculation of each character value is done separately. Based on 9 artifacts related to independent character values, the effect size and summary effect size are obtained. The forest plot of 9 independent character value artifacts shows the effect size and summary effect size (Figure 2).

The results of the analysis of effect size and summary size of discipline character values obtained artifacts that have an effect size in the medium category (N=9). Does not have an effect size in the moderate and strong categories. The resulting summary effect size (0.43) is in the sufficient category. The standard error generated from 9 artifacts of independent character values is in the range (0.05 – 0.15), meaning that the error value generated from 8 artifacts is very small (Figure 3)

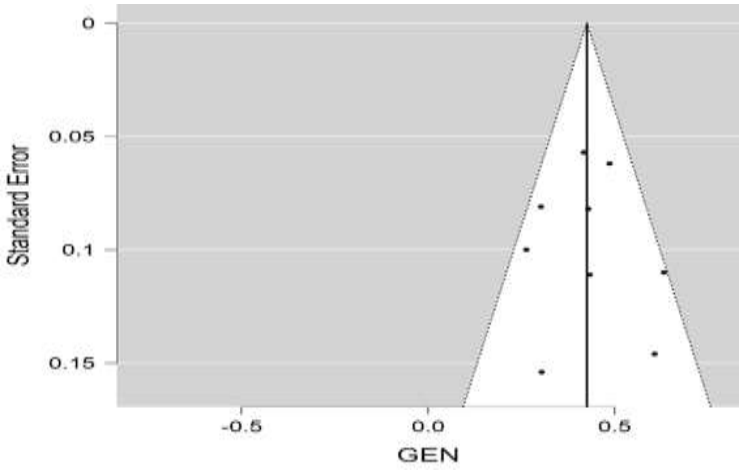

Figure 3. Standard Error of Independent Character Value

Based on 9 artifacts related to the discipline character values obtained effect size and summary effect size. The forest plot of 9 artifacts of discipline character values shows the effect size and summary effect size (Figure 4).

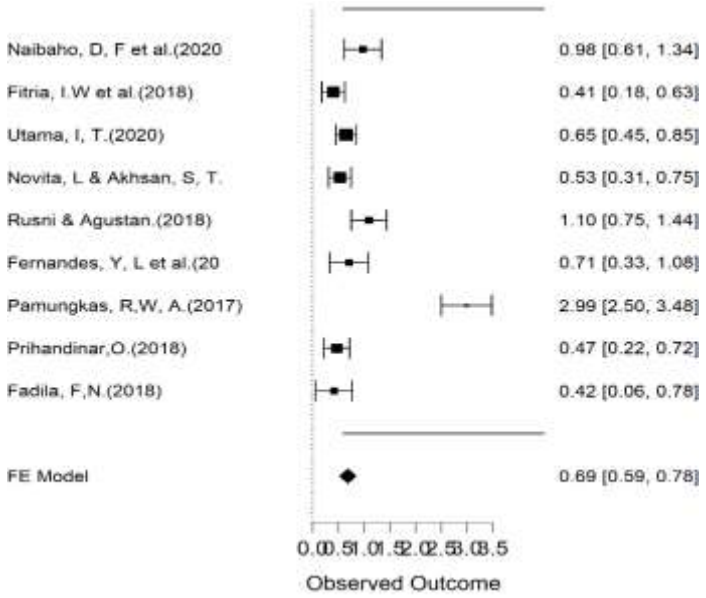

Figure 4. Effect Size and Summary Size of Discipline Character Value

The results of the analysis of effect size and summary size of independent character values obtained artifacts that have an effect size in sufficient category (N=4), medium category (N=4), and strong category (N=1). The resulting summary effect size (0.69) is in the medium category. The standard error generated from 9 artifacts of independent character values is in the range (0.1 – 0.2) meaning that the error value generated from 8 artifacts is very small (Figure 5)

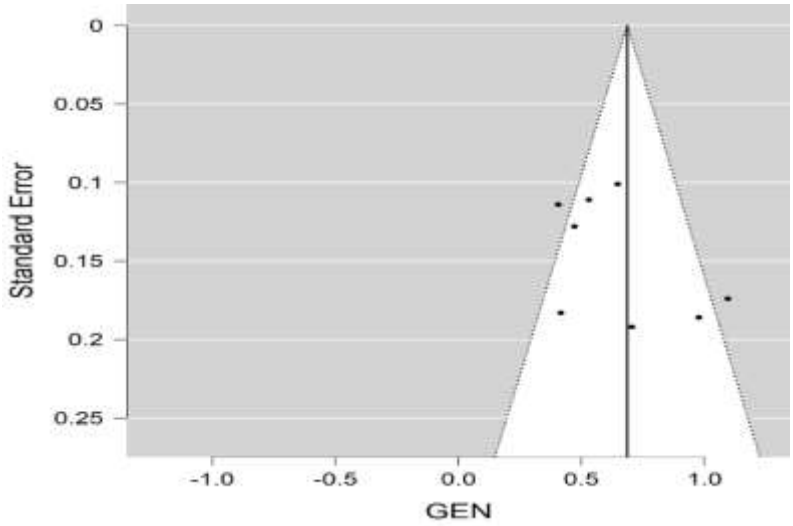

Figure 5. Standard Error of Discipline Character Value

2. Discussion

The success of learning mathematics at the elementary school level is measured by learning outcomes and learning achievement in mathematics. Mathematics learning outcomes are achievements obtained by students after gaining learning experience or after completing mathematical learning activities. Mathematics learning achievement is the result of an assessment after several mathematics learning outcomes are implemented. The success of students' mathematics learning is influenced or related to the characters that are formed and developed in students. Based on the results of this study, it was found that there were two character values, namely independence and discipline which had an impact on students to achieve success in learning mathematics.

The results of the partial analysis of 18 artifacts obtained effect size and summary effect size independent character values and discipline character values. The effect size generated by the independent character values is spread in the medium category. The resulting summary effect size (0.43) is in the sufficient category Cohen et al.(2007) with a very small standard error. The results of the analysis of effect size and summary size of discipline character values are only scattered in the sufficient, medium and strong categories. The resulting summary effect size (0.69) is in the sufficient category (Choen et al. (2007) with a very small standard error. The difference in the resulting Summary effect size indicates that the value of the disciplined character is more developed or entrenched among elementary school students. The character value is independence shown by elementary school students, namely doing math assignments at the beginning without the help of friends or teachers and preparing or repeating the material that has been taught by the teacher (Riyanti et al., 2021). Student independence can be a determining variable for learning success (Krakauer, Ghilardi, & Ghez, 1999). Student independence as an important requirement in graduation at school (Kopzhassarova et al., 2016) Students who are independent in the learning process r without depending on their friends (Riyadi et al., 2021). Independence has a very important role in the success of elementary school students. Disciplined students have high independence, so the character values of independence and discipline are interconnected.

The value of independent character and discipline at the elementary school level continues to be instilled. Principals and teachers have a major role in developing and cultivating these two values. The approach that can be used is habituation and giving examples. The values of independent character and discipline that have been possessed since elementary school become a reference at the level of high school and college. At the secondary school level, it is used to face or follow the Trends in International Mathematics and Science Study (TIMSS) and Program International Student Assessment (PISA), so that it has a good impact on increasing Indonesian students' math scores.

D. Conclusion

Based on 18 artifacts consisting of 9 independent character value artifacts, and 9 discipline character values artifacts, various effect size and summary effect size values were obtained. The effect size generated by the discipline character values is spread in the medium category. The resulting summary effect size (0.43) is in the sufficient category with a very small standard error. The effect size of the discipline character values is spread in the moderate, moderate, and strong categories. The resulting summary effect size (0.69) is in the medium category with a very small standard error. The resulting difference in Summary effect size shows that the value of disciplined character is more developed or entrenched among elementary school students. This finding is useful for principals and teachers in strengthening character education programs. The two character values can be used as a reference in participating in TIMSS and PISA when students are at the high school level. Future researchers can develop this research on the aspect of the number of artifacts used. Comparing the effect size and summary effect size of various character values that develop in elementary school students.

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Development of MeJiKuHiBiNiUn Creative Learning Video Media In Mathematics Subject In Grade V Elementary School

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The digital era is a time when technological developments occur in all parts of the world. As a society that lives in this digital era, we should fallow the current technological developments that we feel. Utilizing technology to solve the problems in the world of education is a wise action. One of the uses of technology in education is to use creative learning video media based on computer technology using the powtoon aplication. The purpose of this research is to develop creative learning video media. The method used is the research and development method in class V SD Negeri 84 Kendari, using the DDD- E method. The data analysis technique used the analysis technique of validation result and the analysis technique of the questionnaire responses of teachers and students. It can be concluded that this creative learning video media MeJiKuHiBiNiUn feasible to be use in the learning process in the fifth grade of elementary school.

Keywords : *Creative learning video, powtoon, development*

A. Introduction

The use of advances in the field of information technology poses a challenge to the world of education, especially in the teaching and learning process. In the National Education System Law No. 20 of 2003, it is stated that it is not the time to rely on a conventional approach in implementing the national education system. The information technology

revolution has changed the way humans work, starting from the way of communication, the way of producing, the way of coordination, the way of thinking, to the way of learning and teaching. From this technological revolution, educational technology was created.

Mathematics is indispensable in everyday life, not only in the process of buying and selling in the market but more in building a way of thinking. Mathematics is one of the important sciences to be studied by every student as the purpose of mathematics is to make humans think logically, theoretically, rationally, and confidently so that it is a means to solve problems in everyday life so that they can compete from all the demands of the globalization era. technologically advanced now and in the future. This statement is also by the results of research from (Supriadi, 2015) in his research connection with the title of developing mathematical connection abilities.

Ruseffendi (2016) states that mathematics is shaped as a result of human thinking related to ideas processes, and reasoning. So, mathematics is not a science that is memorized, but with the understanding that students have, it is expected to be able to understand the concept of the subject matter. Mathematics for some humans is a difficult subject, so many people do not like mathematics.

Mathematics learning in general is still dominated by teachers, which in research (Utami et al., 2018) found that in the learning process in mathematics subjects, students are more passive because of the reason that mathematics is very difficult learning to understand, so the activeness and the independence of students is reduced. In addition, the teacher factor as well as learning media of special concern because the use of learning media in schools is still less than optimal, Wahyunuhari (2013) in his research on sports and health physical education lessons, sees that the lack of media prepared by both the school and the subject teachers themselves, which is where this hampers the learning process, besides depending on the method used it also depends on the learning device used.

One of the problems of education in Indonesia is the low quality of learning, especially in the teaching and learning process. Along with educational problems, the management of learning aids in the form of media is needed to help the teaching and learning process. A research result from the Education Encyclopedia says that learning media provides value/benefits, among others: reducing verbalism, attracting students' attention and interest, encouraging students to ask questions, and the material being studied by students can be more settled and not easily forgotten. In addition, fostering self-employment activities for students because they get real experience in learning, is also one of the reasons for the need to apply learning media in the learning process in the classroom. The use of media in the learning process can also lead to an orderly and running mind and can help the growth of understanding and development of language skills (Usman, 2017). Learning media is a container of messages, while the material to be conveyed is a learning message and the goal to be achieved is the learning process. Creative use of media will increase the possibility for students to learn more, keep in mind what is learned better, and improve performance in performing skills according to the learning objectives.

The learning objectives will run if students can understand the material presented by the teacher, which in this case the learning media is the key to understanding students. Based on the results of research from Development and Research conducted in class X Multimedia SMK Negeri 2 Wonosari. The research resulted in a computer-based Interactive Learning Media product for Graphic Design Basic Lessons using Adobe Flash Professional CS6 Software. The product is packaged in the form of software that is given to students that can be used to study in the classroom or study independently with the help of computer devices. From field research using media, the researcher found that the media he did was feasible to use because students could learn independently. Another study by Oviani (2019) regarding the use of image media in improving elementary school science learning outcomes, in this study stated that the media used were valid because in the comparison of learning without using media, students' interest in learning was low which triggered low learning outcomes, but with the existence of learning media learning outcomes of students to be increased.

In Law No. 20 of 2003, Article 1 paragraph 20, explains that learning media is one of the components that support success in the teaching and learning process. Magdalena et al. (2021) in research on the importance of learning media to increase students' interest in learning, this study is valid because the responses of students in learning are more active and understood because of the help of learning media

Based on the above facts regarding the importance of learning media in the teaching and learning process where the teacher himself should be able to be as creative as possible in the learning process, so that it can have a positive impact on students. The positive impact lies not only in the activeness of students, but how the message from learning can be understood by students.

The function of learning media about the teaching and learning process is as a teacher's tool in delivering learning materials to create an effective learning situation to improve the quality of the teaching and learning process and the interests of students which have an impact on improving learning outcomes and ease of understanding learning materials. Sanjaya (2006) suggests that in particular learning media have functions and roles, namely a) capturing an object or certain events, b) manipulating certain circumstances, events, or objects, and c) increasing passion and motivation to learn. Learning media is useful for clarifying learning information conveyed by teachers to students so that they are not too verbal so that the learning process is more effective and efficient. Learning media also facilitates the interaction of teachers with students wherever and whenever, able to overcome the limitations of space, time, calm and sensory power of teachers and students (Sudiarta & Widana, 2019).

In producing learning media in the form of creative learning videos, where quality learning videos are by the competencies or goals to be achieved. The development of instructional video media requires a series of creative abilities, both creative thinking skills and creative attitudes. The knowledge that must be mastered in developing creative learning video media is knowing about the learning video media itself, knowledge about design and knowledge of the technical implementation of production and evaluation. Therefore, it is necessary to develop and empower creativity in the development of learning videos, which ultimately can produce quality learning videos that are technically and by the needs of students.

Sudrajat (2010) explained that animated video media is a combination of other media elements such as audio, text, video, images, graphics and sound so that it can accommodate the learning styles of students who may have visual, auditory, or kinesthetic types. This animated video is used as a learning medium and will prevent students from feeling bored and tired due to the teacher's explanations that are difficult to digest and understand. To avoid all that, the teacher can develop a learning strategy by utilizing animated video media as a learning aid.

Based on the statement above, shows that in learning a suitable animated video learning media is needed, teachers are required to use various learning media so that the teaching and learning process can run smoothly. One of the animated video applications that are known in the world of education and is often used as a learning medium is the powtoon application.

Powtoon is an online web application that can be used to create presentations with very attractive animation features, such as handwritten animation, animated cartoons, and clear transition effects with very simple timeline settings. The powtoon application first appeared in 2012 and has been growing since 2013 until now. The advantages of this powtoon application are interactive, covers all aspects of the senses, collaborative, can be used in large groups, can be varied, provide make lumbar functions, and motivate users. The drawback of this application is that it relies on an internet connection, and requires basic skills to use it.

From several studies, it is stated that the Powtoon application is declared valid/feasible to be used as a learning medium because it fulfills four aspects of learning, namely aspects of design, pedagogic aspects, content aspects, and convenience which can improve student learning achievement (Julianingrum et al., 2015; Mahendra, 2015; Wisnarni et al., 2016). The use of learning media using the Powtoon application is based on previous research by Asyifa

(2018) who in her research said that learning videos made using the Powtoon application were suitable for use in improving students' understanding of mathematical concepts.

From some of the studies above, because they are considered suitable for use in the learning process, researchers are motivated to develop creative learning video media using the Powtoon application in mathematics subjects in recognizing units of length with the title MeJiKuHiBiNiUn creative learning video media development in mathematics subjects in class V elementary school.

B. Methodology

This research is research that uses research and development or what is commonly referred to as research and development (R&D). This research uses the DDD-E model. The choice of the DDD-E model has based on the reason that this model fits the research conducted, namely creative learning videos, and also because this model is easy to understand. The stages of the DDD-E development model include Decide, Design, Develop and Evaluate (Tegeh et al., 2014). The product in this research is a creative learning video of MeJiKuHiBiNiUn in mathematics subjects in fifth-grade elementary school in length unit subjects using the powtoon application. This research was conducted in September - December 2021 at SD Negeri 84 Kendari, the samples taken can be used as subjects by researchers are students of class V SD Negeri 84 Kendari with a total of 35 students.

This study uses expert reviews or validators and questionnaire responses from teachers and students, to revise and improve the learning videos. Validators consist of design experts, media experts, and materials experts. In this study, there is a preparation procedure carried out by researchers for development activities, namely Decide, Design, Develop and Evaluate. The data analysis technique used in this research is quantitative descriptive analysis and qualitative descriptive analysis. The qualitative descriptive analysis technique is used to manage data from the results of expert trials and student trials conducted by grouping information obtained from qualitative data in the form of interviews, comments, responses, and suggestions for improvement from experts. The results of this data analysis will be used to revise the developed product. While in the form of numbers or percentages to get general conclusions, it is obtained through questionnaires from experts and students' responses to creative learning media.

The results of the validation percentage from the experts and the teacher and student responses can be grouped in the score interpretation criteria according to the Likert scale so that conclusions will be obtained about the feasibility of the media, the score interpretation criteria based on the Likert scale as follows:

Table 1 Assessment Criteria according to the Likert Skala Scale

Rating	Interpretation Criteria
80 % - 100%	Very Clear (VC)
60% - 80%	Clear (C)
40% - 60%	Quite Clear (QC)
20% - 40%	Unclear (Un)
0% - 20%	Very Unclear (V Un)

With the categories provided by the researcher based on a Likert scale consisting of 5 rating scales as follows:

Table 2. Rating Scale

Answer options	Score
Very Clear	5
Clear	4
Quite Clear	3
Unclear	2
Very unclear	1

The results of the teacher and student response questionnaires were analyzed using the following formula:

$$p = \frac{f}{n}\ x\ 100\%$$

Information :
P = percentage of questionnaire data
f = total score obtained
n = number of maximum scores

C. Results and Discussion

Interactive multimedia in mathematics lessons was developed using the DDD-E development model which consists of four stages, namely the first stage is Decide, at this stage the learning objectives are set by conducting interviews with the fifth-grade homeroom teacher at SD Negeri 84 Kendari regarding the use of creative learning media, With this, the researcher determines the theme of the scope of the material to be discussed in multimedia, development of prerequisite skills and assesses resources. The second stage is Design, at this stage what is done is making content outlines, flowchards, designing initial views, storyboards to facilitate the development of interactive multimedia products. The application that will be used in this creative learning is the powtoon application. The third stage is Develop, where at this stage the products that have been designed and designed will be developed into real products based on the flowchards and storyboards that have been made. What is done at this stage is to aggregate all the products that have been made using the powtoon application so that they become creative learning media. At this stage the products that have been made will be assessed by experts, namely design experts, media experts, and material experts and questionnaires for teacher and student responses. The last stage is evaluation, where at this stage the evaluation is not only carried out on the final product, but the evaluation is also carried out starting from the decide, design and develop stages. Evaluation of the products developed will be carried out by the suggestions and input from design experts, media experts, and material experts. By evaluating at each stage, it can minimize the error rate of the product being developed.

The development of the MeJiKuHiBiNiUn creative learning video that has gone through validation tests by design experts, material experts, media experts and teacher and student response questionnaires, is seen in table 3.

Table 3. Product Validation Test Results

No	Creative Learning Video Trial Subject	Results Validity (%)	Information
1	Design expert test	95,55 %	Very Clear
2	Media expert test	93,33 %	Very Clear
3	Material expert test	100 %	Very Clear
4	Teacher response	100 %	Very Clear
5	Students response	93,2	Very Clear

Based on the results of the assessment carried out by media design experts, the developed media reached 95.55% so it got very clear qualifications. The results of the assessment carried out by media experts reached 93.33% with very clear qualifications. The results of the assessment carried out by material experts reached 100% with very clear qualifications. The teacher's response to the MeJiKuHiBiNiUn creative learning media reached 100% with very clear qualifications and the response from students, it reached 93.2% with very clear qualifications. Some suggestions and comments from experts and questionnaire responses from teachers, where suggestions, comments and input are then used as suggestions for making improvements or revisions so that the creative learning media products developed are better. The results of developing this creative learning video are shown in the image below:

Based on the validation test of the feasibility of creative learning videos by experts and questionnaire responses by teachers and students, the overall qualifications are very clear, so that they are feasible to be applied in the learning process. One of the causes of very good qualifications is because in the design of interactive multimedia development using the DDD-E model because every step in the DDD-E model is very systematic and it is always possible to carry out evaluations to make the quality of the media produced will be better (Nendasariruna et al., 2018; Setianinggrum, 2020). Creative learning videos using the powtoon application are feasible to be applied in the learning process due to several factors, namely because the powtoon application is a learning guide for students independently, MeJiKuHiBiNiUn creative learning video media in mathematics subjects with unit length material makes learning more fun, not monotonous and makes it easier for students to calculate units of length, which students can also apply this in life. In everyday life, this media uses interesting animations, and illustrations that can make it easier for students to understand the material.

As a learning guide for students independently, MeJiKuHiBiNiUn creative learning video media in mathematics subjects with unit length material makes learning more fun, not monotonous and makes it easier for students to calculate units of length, which students can also apply in everyday life as well as media. It uses interesting animations, and illustrations that can make it easier for students to understand the material. This is based on previous findings by (Julianingrum et al., 2015; Mahendra, 2015; Wisnarni et al., 2016), their research results revealed that the Powtoon application was declared feasible to be used as a learning media because it fulfilled four aspects, namely, design aspects, pedagogic aspects, content aspects, and convenience aspects in this case, namely the convenience for students. students to understand the subject matter. And research from Asyifa (2018) which in the study stated that learning videos made using the Powtoon application were suitable for use in improving students' mathematical understanding.

Based on the existing findings, it illustrates that the powtoon application presents a fun learning atmosphere. This research does something different from previous research, namely by making a color combination strategy and making acronyms so that it can help students learn to recognize units of length and the results of its application have a positive impact on student learning outcomes.

D. Conclusion

MeJiKuHiBiNiUn's creative learning videos get very clear qualifications. So this creative learning video can be used in the learning process. It is recommended for teachers to use this MeJiKuHiBiNiUn creative learning video that can help students learn mathematics, especially in unit - length material.

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Problem Solving Profile of Students with High Self-Efficacy Levels in terms of Gender

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Abstract

This research is motivated by the low mathematical problem-solving ability of MTs students. The purpose of the study was to describe the problem-solving profile of students with high self-efficacy in terms of students gender. The research method is qualitative research, where the research subject consists of one male student and one female student with a high level of self-efficacy from MTs students in class VIII-A. The main instrument is the researcher himself, supported by problem-solving tests, self-efficacy questionnaires, and interview guidelines. The data analysis technique was carried out using stages, namely: data reduction, data presentation, and conclusion. The results showed that in solving problems male students with high self-efficacy were superior to female students with high self-efficacy, namely: (1) In The stage of understanding the problem, male and female students with high self-efficacy were able to name all that information known and asked. (2) In the planning stage, male and female students with high self-efficacy are good enough in determining strategies. (3) In the stage of implementing the plan, male and female students with high self-efficacy were following the planned strategy. However, in practice, female students with high self-efficacy make many mistakes, so the results obtained are not correct. (4) In the re-examination stage, male and female students with high self-efficacy re-examine the results of their answers.

Keywords: *problem-solving, self-efficacy, gender*

A. Introduction

Problem solving is an ability that students must have in learning mathematics. Most mathematics educators may agree that the development of students' problem-solving skills is an important goal of teaching (Haavold & Sriraman, 2022). Purba & Sirait (2017) state that problem solving plays an important role in mathematics education from elementary to secondary level students. Problem solving is a core goal in learning mathematics at school and is an important skill

needed in everyday life (Chang & Zhou, 2022; García et al., 2019; Surya & Putri, 2017; Ummah & Yuliati, 2020) . Lester (2013) emphasized that "Problem solving is the heart of mathematics" which means that the heart of mathematics is problem solving. Problem solving abilities provide great benefits to students in seeing the relevance between mathematics and other subjects, as well as in real life (Latifah & Afriansyah, 2021). Therefore, in learning mathematics problem solving has a very important role.

(Krulik & Rudnick (1995) define problem solving skills as a means for individuals to use previously possessed knowledge and abilities to synthesize and apply to new and different situations. Problem solving situations are a challenge and a critical moment for students in an effort to find solutions. Problem solving is identified as a process in which individuals seek solutions to the problems they encounter (Öztürk et al., 2020). Problem solving is an ability that involves various processes including analyzing, interpreting, reasoning, predicting, evaluating and reflecting (Lestari & Afriansyah, 2021). Problem solving can be interpreted as a process in achieving a goal that involves self-ability and skills. To solve or solve the problem, the right steps are needed to get the best solution.

Based on the description above, students should have problem solving abilities. However, in reality, the ability to solve problems in Indonesia is currently still low. Problem solving ability is a difficult thing for students to achieve. This is justified by (Khatimah & Sugiman, 2019) which states that the activity of studying questions that are considered difficult by students requires problem-solving skills. This happens because students only learn according to the example given by the teacher, so that when given non-routine questions (mathematical problems), students will experience errors (Malalina & Kesumawati, 2014). In line with Wasiran (2019) which states that, students are too used to thinking procedurally so they are prevented from responding and solving problems. Low problem-solving abilities also result in low student learning outcomes.

In the 2018 PISA triennial survey, Indonesia is ranked 72nd out of 78 countries in the field of mathematics. One of the factors that causes low PISA achievement in mathematics in Indonesia is the low ability to solve math problems in schools (Inayah, 2018). Strengthened by the results of observations made by researchers on MTs class VIII-A students. Based on the average value of the test results, it was concluded that students' problem-solving abilities were still relatively low with an average score of 65.4. Besides that, from the results of an interview with one of the mathematics teachers at the MTs, researchers obtained information that there were still many students who had difficulty working on problem solving questions. Students tend to be able to work on it if the model questions given are exactly the same as the examples of questions being taught, in the sense that students are only used to routine questions.

There is a link between problem solving and students' self-efficacy. Self-confidence (self-efficacy) has a function as a tool for assessing student success in solving problem solving questions (Surya & Putri, 2017). Riskiningtyas & Wangid, (2019) state that a person's low achievement is caused by the person's low self-confidence in solving mathematical problems. Students who have self-confidence (self-efficacy) see that mathematics is important for their lives and help them solve mathematical problems in a fun way, but they do not have self-confidence (self-efficacy) to be able to solve these mathematical problems. In line with research by (Widajati et al., 2018) which states that in order to face and solve social problems, students must have self-confidence (self-efficacy). Riskiningtyas & Wangid (2019) state that self-efficacy plays an important role in achievement motivation, is interconnected with self-regulating learning processes, and mediates academic achievement.

Self-efficacy (self-confidence) is a belief that students must have in order to be successful in the learning process. Self-confidence or self-efficacy is one's ability to solve problems in order to obtain the desired results (Bandura, 1997). Students who have high self-efficacy will be able to solve math problems. Student self-efficacy refers to beliefs about what they are capable of achieving, rather than what skills and abilities they think they have. Self-efficacy can affect students' persistence or persistence in solving problems (Wiharso & Susilawati, 2020; Yeşilyurt et al., 2016). Students who have strong self-confidence will diligently face problems to obtain solutions and vice versa, students who have weak self-confidence will tend to give up easily when facing a problem.

Self-efficacy determines how much effort students will make and how long students survive facing obstacles (Handayani, 2013). In addition, self-efficacy also affects the achievement of student achievement. Furthermore, (Tjiong, 2014) states that the more confident students are about their abilities, the better their decision-making abilities will be. Based on these opinions, it can be said that self-efficacy plays an important role for students in solving math problems. Therefore, self-efficacy abilities must be developed in students so they can interpret the process of learning mathematics in real life, so that the learning process occurs optimally, and can improve problem solving skills.

Each individual can be divided into two genders, namely men and women. In addition to the self-efficacy factor, from these gender differences there are differences in problem solving skills between women and men. Gender differences are innate differences between men and women that can change at any time through the efforts made. Wilkinson & Pickett (2017) states that there are significant differences between male and female students with regard to abilities in solving mathematical problems. When faced with problems based on problem solving, male and female students have different problem-solving tendencies (Nur & Palobo, 2018). Krutetskii (1997) states that men are superior in terms of reasoning and have better mathematical and mechanical abilities although this difference is only apparent at higher levels. While women are superior in accuracy, thoroughness, thoroughness and thoroughness of thinking. This is in line with Nur and Palobo's research (2018) which shows that male students' problem-solving skills are better than female students. This is due to the poor ability to understand problems of female students. Female students have difficulty visualizing existing problems. The mathematical skills of female students are also very low, so that students have difficulty solving a problem. (Gaspard et al., 2015) revealed that the level of intrinsic motivation of female students was lower than that of male students. Female students found mathematics less useful for the future and had higher levels of intrinsic motivation to learn the language. Regarding gender differences, international studies show that there are differences in the average level of academic self-concept between boys and girls according to the dominant gender stereotypes. Girls have a higher self-concept in the verbal domain (Heyder et al., 2017; Jacobs et al., 2002), and boys have a higher self-concept in mathematics (Fredricks & Eccles, 2002; Jacobs et al., 2002; Marsh, 1989; Wilgenbusch & Merrell, 1999).

Meanwhile, on the other hand, the results of research by Aras, et all (2019) show that female students have better mathematical problem-solving abilities compared to male students, where male students tend to be quickly satisfied with what they get even though the completion process is sometimes there is an unnoticed error. Theoretically, female students perform better than male students because they are more motivated and work more diligently in doing school work, women's self-confidence is better than men and women prefer to read than men (Santrock & Cordero, 2012). Several other studies have also shown that the mathematical problem-solving abilities of female students are superior to male students in all indicators of problem solving (Anggraeni & Herdiman, 2018; Davita & Pujiastuti, 2020). This is because female students are better able to handle holistic problem solving, where female students are more focused on the problem-solving process used not the results obtained. This is in line with Nur & Palobo's research (2018) which states that female students are better able to handle holistic problem solving while male students are stronger in analyzing specific problems.

Based on several previous studies, it is known that there are differences of opinion regarding students' mathematical problem-solving with different genders. Several studies have shown that male students are superior in solving math problems. However, some other studies also show that in solving math problems female students are superior to male students. Thus, the existence of these differences of opinion encourages researchers to conduct more in-depth research related to the problem-solving profile of students with high levels *of* self-efficacy, which is influenced by gender.

B. Methodology

1. Research Design

This research is qualitative research. It is called qualitative research because all the facts, both written and oral, from human data sources that have been observed and other related documents

are described as they are, then studied as briefly as possible to answer the problems studied. This research was conducted in class VIII-A of MTs Negeri 6 Pasuruan, the academic year 2021/2022 with a total of 22 students. From 22 people, 2 people were selected as research subjects consisting of 1 male student and 1 female student with high self-efficacy.

2. Instruments

The instrument used in this study consisted of the main instrument and the supporting instrument. The main instrument is the researcher himself, while the supporting instruments are self-efficacy questionnaires, problem-solving test sheets, and interview guidelines. The three instruments have been validated in terms of content and construction by 3 validators. The self-efficacy questionnaire was used to determine the research subject. The questionnaire consists of 30 statement items with detailed scores for each answer choice using a Likert scale which is presented in Table 1 below.

Table 1. Self-efficacy Questionnaire Response Format Score

Category Student Answers	Questionnaire Item Score	
	Positive	Negative
Strongly Agree (SS)	4	1
Agree (S)	3	2
Disagree (TS)	2	3
Strongly Disagree (STS)	1	4

Data from the self-efficacy *questionnaire* were analyzed using a range of scores with calculations referring to Azwar (2015) Self-efficacy is classified into high, medium, and low levels. However, in this study students will only be grouped into the classification of high self-efficacy which is reviewed based on gender according to the research objectives. Thus the high and low *self-efficacy* of students are classified as follows.

Table 2. Student Self-efficacy Grouping Criteria

Criteria	Category
$\boldsymbol{x \geq (\bar{x} + SD)}$	Tall
$\boldsymbol{(x - SD) < x < (\bar{x} + SD)}$	Currently
$\boldsymbol{x \leq (\bar{x} - SD)}$	Low

The problem-solving test sheet is used to find out the steps of student completion in solving mathematical problems. The test is given in the form of *essay questions*. The results of the problem-solving test were analyzed using the problem-solving steps (Polya, 2004).

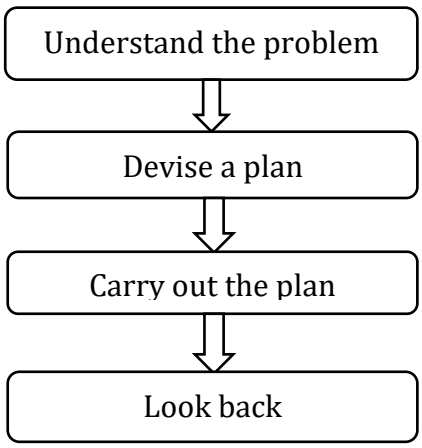

Figure 1. Steps to Solve Polya's Problems (1973)

In addition, to complete the information regarding the profile of students' mathematical problem-solving, interviews were conducted. The interviews conducted in this study were semi-structured. The validity of the data was obtained through the triangulation technique. The data triangulation used in this study is time triangulation, which is to compare and check the validity of the information obtained at different times. In this case, the researcher checked the suitability of the data obtained from tests 1 & 2 and interviews 1 & 2 to obtain valid data.

3. The technique of Data Analysis

The data obtained were analyzed by referring to the data analysis model from Miles & Huberman (1994), where there are three steps of data analysis activities, namely: data reduction, data presentation, and conclusion drawing.

C. Findings and Discussion

1. Findings

Based on the data analysis of the self-efficacy questionnaire results, 2 research subjects were selected, namely 1 male student and 1 female student who had high self-efficacy with the highest questionnaire score. Because this research is qualitative research that is intended to explore deeply subjects who have a high level of self-efficacy and is not intended to be generalized. Representatives of two subjects are sufficient to provide information about the problem-solving profiles of students who have high self-efficacy in terms of gender. The questionnaire scores of the two subjects were used to determine the classification of research subjects as follows.

Table 3. Classification of Research Subjects

No.	Student's name	Gender	*Self-Efficacy* Questionnaire Score	Student Code
1.	MIR	Man	112	LT
2.	NLK	Woman	108	PT

Based on the data analysis of the results of mathematical problem-solving tests and interviews that have been conducted on the two research subjects above, they are presented as follows.

Problem-solving profile of male students with high *self-efficacy* (LT)

a. Stage of Understanding the Problem

The following is a snippet of the results of the LT subjects' answers.

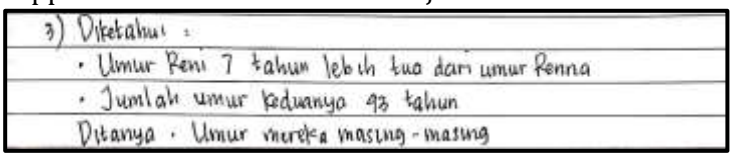

Figure 2. Results of LT Subjects' Answers at the Problem Understanding Stage

In Figure 1, it can be seen that the LT subjects wrote down the things that were known and asked correctly and in accordance with the information contained in the questions. LT subjects wrote it down sequentially according to the order of information listed on the question and wrote everything completely without missing any information on the answer sheet. The subject writes completely what is known and asked in the form of a sentence. In addition to excerpts from the subject's answers, here are excerpts from interviews that show the subject's activities at the stage of understanding the questions.

P : *Based on the questions you have read, explain what information you found in the questions?*

LT : *It is known that Reni is 7 years older than Renna. If their ages are combined the total is 43 years. Then what is asked from the question is their age, how old is Reni, how old is Renna. So sis.*

Based on excerpts from interviews with LT subjects, it is known that the subjects understood the problems given well. LT subjects were able to retell the problems given using their language without changing the meaning of the problem. In addition, LT subjects can also mention all information, namely things that are known and asked in the question clearly and correctly.

b. Making Plans

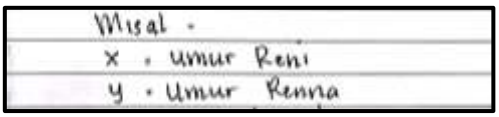

Figure 3. Results of LT Subjects' Answers at the Planning Stage

P : *What is your strategy for solving this problem?*
LT : *Suppose first into x and y, namely x for Reni's age and y for Renna's age.*
P : *Okay, then is that all?*
LT : *Make an equation from the problem, then calculate it using a mixed method, namely the elimination-substitution method*

At this stage, the LT subjects developed a problem-solving plan quite well. The subjects mentioned in detail the plans that had been made, starting with making more detailed examples, where x was Reni's age and y was Renna's age. Then the subject plans to make an equation. After that, calculate the results using a mixed method, namely the elimination-substitution method. However, at this stage, there is a slight drawback in that the LT subject does not explain the number of equations needed to calculate the results.

c. Executing the Plan

The following is a snippet of the results of the LT subjects' answers.

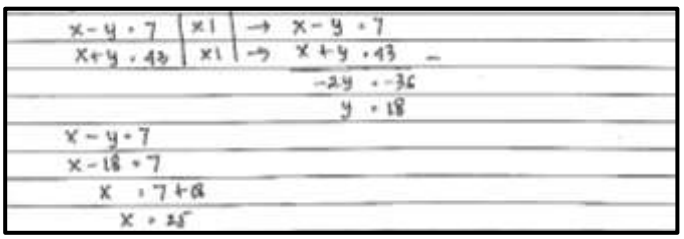

Figure 4. Results of LT Subjects' Answers at the Stage of Implementing the Plan

In addition to excerpts from the subject's answers, the following is an excerpt from an interview that shows the subject's activities at the stage of implementing the plan.

P : *Explain every step you take in solving the problem!*
LT : *(While pointing to the results of problem-solving that has been done) from what is asked in the question, suppose into x and y, then make equations 1 and 2, equation 1 is* $x - y = 7$ *and equation 2 is* $x + y = 43$*. Next, I look for the value y first by means of elimination x. To eliminate x, all equations are multiplied by 1, so that the value of* $y = 18$*. After that, the value x that has been replaced can be substituted into equation 1. The variable y in equation 1 is replaced with 18 so that the value of* $x = 25$*. Where x is for Reni's age which is 25 years and y for Renna's age 18 years.*

Based on the results of the subject's answers in Figure 4 and the interview footage, it can be seen that the LT subject wrote down the steps used to solve the problem and did the calculations correctly to get to the final solution. From Figure 3, it can be seen that the solution written by the LT subject was following what had been planned and did not find any problems when working on the problem. LT subjects can build links between the settlement plans used and the knowledge

they have to solve problems. As seen in the results of the answers, LT subjects made two linear equations correctly and used mixed methods to determine the value of each variable. However, in the answer sheet, the LT subjects did not write down the method used. The LT subject directly eliminates and substitutes equations (1) and (2). LT subjects work on and write step by step in a coherent manner from beginning to end. In addition, at the time of the interview, the subject was able to explain the steps taken clearly and in detail.

d. Check again

The following is a snippet of the results of the LT subjects' answers.

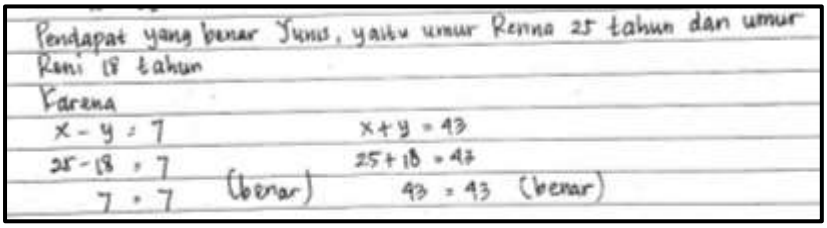

Figure 5. Results of LT Subjects' Answers at the Re-Checking Stage

In addition to excerpts from the subject's answers, the following is an excerpt from an interview showing the subject's activities at the re-examination stage.

P : *Are you sure about the answer you got?*
LT : *sure sis*
P : *Did you double-check your answers?*
LT : *Yes, to make sure the answer is right or wrong.*
P : *What method did you use to double-check your answer?*
LT : *The trick is to re-examine the process, especially in the process of calculating it.*
P : *Is there another way to double-check your answer?*
LT : *Yes, that is by substituting the value x and y which I got into equations 1 and 2, bro (while pointing to the answer sheet). I've done it and the results are also correct sis*
P : *Have the answers you received answered the questions?*
LT : *Already sis. The answer I got was following the information in the question, namely Reni's age was 25 years and Renna's age was 18 years. Where Reni's age must be older than Renna's age because Reni is Renna's older sister.*

Based on Figure 5 and the interview excerpt above, the LT subjects have re-examined the results of their answers by examining the workmanship and the process of calculating them from beginning to end before being collected. In addition, the LT subjects also rechecked the results of their answers by substituting the x and y values obtained into equations 1 and 2, to ensure the correctness of the answers that have been obtained. When substituted, the obtained x and y values are appropriate. LT subjects believe in the correctness of the answers that have been obtained and the results they get have answered the questions in the questions.

Problem-solving profile of female students with high self-efficacy (PT)

a. Understanding the Problem

The following is a snippet of the answers to the subjects of PT.

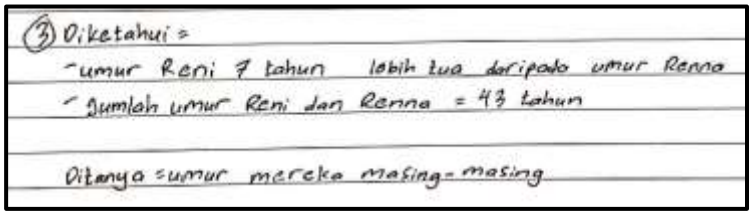

Figure 6. Results of PT Subject's Answers at the Problem Understanding Stage

In Figure 6, it can be seen that the subject of PT wrote down all the information, namely things that were known and asked correctly and following the information contained in the questions. PT subjects also wrote it down sequentially according to the order of the information listed on the question and wrote everything down completely without missing any information on the answer sheet. The subject of PT writes down what is known and asked in the form of a sentence. In addition to excerpts from the subject's answers, here are excerpts from interviews that show the subject's activities at the stage of understanding the questions.

P : *After reading the questions, what can you understand from the questions?*
PT : *At first, I was confused because I thought it was quite difficult. But after reading it over and over again I understand better what the question is about.*
P : *Can you explain the meaning of this question?*
PT : *Asked to find out how old Reni and Renna are*
P : *What information did you find in the question?*
PT : *It is known that Reni is 7 years older than Renna and the sum of their ages is 43 years. They were asked how old they were.*
P : *Apart from the information you mentioned, did you find any other information from this question?*
PT : *Hmmm... what else? That's all maybe*

Based on excerpts from interviews with PT subjects, it is known that the subjects have understood the problems given quite well. At first, the PT subject could not understand the meaning of the question, but after reading it repeatedly, the PT subject finally understood the meaning of the question. So it can be seen that in understanding the problem, PT subjects need to read repeatedly to build a link between the information available in the problem and the knowledge they already have. In restating the problem, the PT subject retells the problem by reading the question without changing the word and the meaning of the problem. The subject of PT mentioned things that were known and asked clearly. However, when asked again whether there was any other information found from the question, the PT subject was able to answer correctly and hesitated in answering.

b. Making Plans

The following is a snippet of the answers to the subjects of PT.

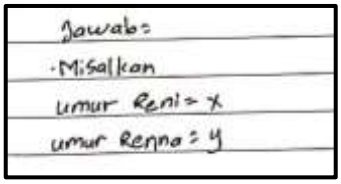

Figure 7. Results of PT Subject's Answers at the Planning Stage

In addition to excerpts from the subject's answers, the following is an excerpt from an interview that shows the subject's activities at the planning stage.

P : *What is your strategy for solving this problem?*
PT : *Suppose x and y. Then make equations 1 and 2 of the problem. After making the equation, calculate using the elimination method to determine one of the variables. Well, after I found one variable, I substituted it into one of the equations that had been made earlier to determine the other variable.*

At the stage of making a problem-solving plan, the subject of PT developed a problem-solving plan quite well. This is because the planning made by the subject of PT is not complete. The planning starts with making an example of x and y. Here the subject does not explain more

specifically that the values of x and y are Reni's age or Renna's age. The next plan is to make two equations. The subject already knows that solving this problem requires two equations. After that, the LT subject explained the steps to be taken in sequential counting. However, the subject did not clearly explain the type of method used to execute the two equations.

c. Executing the Plan

The following is a snippet of the answers to the subjects of PT.

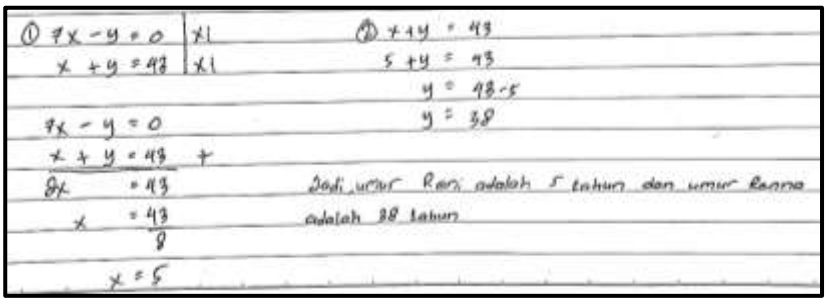

Figure 8. Results of PT Subject's Answers at the Stage of Implementing the Plan

In addition to excerpts from the subject's answers, the following is an excerpt from an interview that shows the subject's activities at the stage of implementing the plan.

P : *Explain every step you take in solving the problem!*

PT : *(While pointing to the answer) this is for equation 1, 7x - y = 0 and this is equation 2, x + y = 43. After that, eliminating x, all equations are multiplied by 1. So that we get* $x = 5$*. Then, the value of x = 5 is substituted into equation 2 to get the value of y = 38. So, Reni's age is 5 years and Renna's age is 38 years.*

P : *Okay. How do you get this equation?*

PT : *Actually, I'm confused about changing from a sentence into an equivalent form, bro. As for my answer, my thoughts are like this, for equation 1, Reni's age is 7 years older than Renna's age. Let's say Reni's age was x, I just joined 7x. So equation 1 is* $7x - y = 0$*. For equation 2, the sum of their ages is 43 years, meaning that if you add their ages, they are 43 years old. So, equation 2 is obtained* $x + y = 43$*.*

P : *In the y-elimination process, is 43÷8=5 (while pointing to the subject's answer)?*

PT : *When I calculate the result, the result is a comma, Sis, then I round it to 5 because people's ages have to match the numbers.*

At this stage, the subject of PT implements the problem-solving plan poorly. This is because the subject of PT is less precise in making one of the equations, namely the first equation, the subject writing 7x-y=0 should be xy=7. The subject also could not explain well where the equation came from, the subject only answered according to his instincts which he thought was right because from the start he found it difficult to convert a sentence into his mathematical model. Based on Figure 8, it can be seen that the subject performs calculations using a mixed method, namely the elimination-substitution method. However, the LT subjects did not write down the method used. In addition, the subject also made an error in the elimination process, namely when performing the division calculation operation so it affected the next step and caused the results obtained to be inaccurate. Therefore, it can be said that the subject is less thorough.

d. Check again

The following is an excerpt from an interview with the subject of PT.

P : *Did you double-check your answers?*

PT : *Yes, but only briefly.*

P : *What method did you use to double-check your answer?*
PT : *Look again at the results of the answer and corrected again the calculation.*
P : *Is there another way you can check your answers?*
PT : *Nothing, bro, that's all.*
P : *Are you sure that your answer is correct? What is the reason?*
PT : *Not sure sis, for fear of being wrong in the equation.*

At the stage of re-examining the completion, the PT subject admitted to re-examining the results of his answers by examining the results of his work and recalculation, but this was done at a glance, not in its entirety. The PT subject felt less sure of the correctness of the answer he had received because he was doubtful about one of the equations he made earlier.

2. Discussion

The results showed that male students with high self-efficacy were able to understand the problems given well, starting with explaining the existing problems using their own language, so that they could state what information was known and ask the questions correctly. When making a problem-solving plan, male students with high self-efficacy are good enough at determining what strategies will be used in solving problems, although there is a little incomplete information. In implementing the problem-solving plan, male students with high self-efficacy were following the planned strategy and in its implementation it was appropriate. Male students with high self-efficacy work on and explain the methods used in solving these problems well, and feel confident with the results of their calculations. Some of the things above are following the opinion of Santrock (2012) that male students have high self-confidence in mathematics.

Re-checking the answers, male students with high self-efficacy conduct a thorough re-examination of the results of their work before they are collected, namely by substituting answers based on what is known on the question and checking the answer algorithm procedure based on the rules of mathematical elaboration. Male students with high self-efficacy have a strong belief in the results of the answers they get by doing an inductive proof. Male students with high self-efficacy can overcome difficulties in solving the given problems and have high accuracy in solving problems so that they re-check the answers obtained including the completion algorithm. This fact is not following the opinion of Aras (2019) who states that male students will feel satisfied with what they get even though in the completion process sometimes there are errors that are not realized, so male students feel no need to re-examine.

While on the other hand, in understanding the problems of female students with high self-efficacy, This is done by repeatedly reading the given problem until the problem is well understood and mentioning the information contained in the problem, namely what is known, and asking about the answer sheet correctly. Based on this, it is following Sudia's opinion (2016) that female students realize the importance of understanding the problem, which is done by reading the problem several times until the problem is completely understood. In making a problem-solving plan, female students with high self-efficacy are quite good at determining what strategies will be used in solving problems, although there is a little incomplete information. When implementing the problem-solving plan, the problem-solving steps of female students with high self-efficacy were according to the plan, but there were many errors in its implementation, including not being able to make equations correctly and errors in calculations when eliminating. At the re-examination stage, female students with high self-efficacy only checked their work in passing, so the solutions obtained were less precise and less thorough, even though the written solutions were following the plans made. Female students with high self-efficacy admitted to having difficulties in solving these problems, especially in converting sentences into their mathematical models.

D. Conclusion

The results showed that the problem-solving abilities of male students with high self-efficacy were superior to female students with high self-efficacy. This can be seen from the results of student work, where at the stage of implementing the problem-solving plan male students with

high self-efficacy can solve the problems given correctly and follow the plans made previously, in contrast to female students with high self-efficacy who make many mistakes in their implementation and are very less thorough, so the results obtained are not correct, it is also supported by the statement of female students with high self-efficacy that they find it difficult to solve these problems.

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Deductive Reasoning of Student Teacher Candidates: A Study of Number Theory

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Abstract

Deductive reasoning which includes generalizing, justifying, exemplifying, comparing, and classifying is the main feature of studying mathematics. This study aims to describe qualitatively the deductive reasoning of second-semester mathematics teacher candidates in studying number theory. This research is a qualitative descriptive study with mathematics teacher candidates who have equal mathematical abilities and are of the same sex, namely women as research subjects. The results showed that the two subjects met the indicators of deductive reasoning, namely making general statements, making special statements, and concluding. This could be caused by the characteristics of prospective teacher students in receiving, storing, processing, and how to solve problems or what is called cognitive style.

Keywords: *Deductive Reasoning, Student Teacher Candidates, Number Theory*

A. Introduction

(Loewenberg Ball et al., 2008), understanding mathematics has no meaning without serious reasoning emphasis. When an individual has an understanding without reasoning, the understanding that the individual has is meaningless. Reasoning and proof are the basis of mathematical understanding. Learning to think and reason is very important for the growth of mathematical knowledge. In the process of justifying, individuals naturally build their arguments when doing proof or solving problems. Reasoning and proof form the foundation of understanding mathematics.

(Mueller & Maher, 2009), reasoning and proof are the basis of mathematical understating The study of proof in matters is often associated with deductive reasoning which requires analytical reasoning. Deductive reasoning which is logical reasoning is a pillar of reasoning related to mathematical proof and argumentation, even related to communication and problem-solving. Difficulties in using deductive reasoning are experienced by mathematics students at various levels of education. Likewise, difficulties in deductive reasoning are experienced by student teacher candidates, especially math teacher candidates. Prospective mathematics teachers usually experience many obstacles and even fail to carry out formal proof. This is also usually experienced by most people when faced with a problem situation that requires logic in solving it.

(Hegel, 2001), all reasoning is thinking, but not all thinking is reasoning. Only the thought process that is based on data, evidence, or systematic rationale for concluding is reasoning. There are many mental processes or types of thinking that differ from reasoning. Someone can remember or imagine something without reasoning, or it can be said that someone thinks not necessarily reasoning.

Deductive reasoning needs to be developed in problem-solving or when someone is faced with conditions that are not normal or challenging. If there is a question about the ability of school-age children in deductive reasoning, then the same goes for student-teacher candidates. Prospective teacher students need logical reasoning when facing challenging problems or rather complicated problems, especially problem-solving questions because deductive reasoning is a high-level skill needed by students, especially prospective mathematics teacher students. Solving mathematical problems requires a deductive mindset which means that the process of doing mathematics is deductive. Mathematics accepts generalizations based on observation (inductive) but must be based on deductive proofs. Reasoning, the deduction is a thinking process that starts from existing proportions, leading to new propositions in the form of a conclusion.

(Ju & Choi, 2017), deductive reasoning is a process toward a special truth that is built from general truths. A reasoning that ends in a common event, that is, the truth is known and ends in a conclusion. So, deductive reasoning is a thought process that is general truth to special truth which ends with concluding. To find out how individual deductive reasoning can be seen from their ability to solve mathematical problems. Through the activities of solving mathematical problems, individuals can develop and build new ideas from existing knowledge. In solving math problems student teacher candidates will gain experience using the knowledge and skills they must apply to solve challenging problems.

A proposition is a statement in the form of a sentence that is judged to be true or false. A proposition is a statement that describes several conditions that are not necessarily true or false in the form of a sentence. The truth of a proposition corresponds to facts, a false proposition does not correspond to facts. In this study, the proportions used as the basis for conclusions are called general statements or special statements as well as the results of the conclusions. Deductive reasoning is a conclusion that departs from things that are general to specific things and is a conclusion that the process involves theories or other mathematical formulas that have previously been verified (Stylianides & Stylianides, 2013). Deductive reasoning is closely related to the process or activity of thinking to draw conclusions or make new statements by using or involving theories that have previously been proven true.

(Ayalon Michal and Even Ruhama, 2010), Deductive reasoning is a conclusion as an affirmation of what is already implied in the premise. This shows that the conclusion is a logical necessity of the premises and must be true if the premises are true. This means that if the premise is true, then the conclusion must also be true. Deductive reasoning is the truth of a concept or statement obtained as a logical consequence of the previous truth. (Lin & Guo li Taiwan shi fan da Xue., 2009) say that when someone reasons, someone uses prior knowledge about the truth of one or more statements to determine the truth of other statements. When someone reasoned the thing, he got a conclusion. In this case, to prove the truth of a statement, someone is doing the reasoning.

(El et al., 2008), states that problem-solving and proof are impossible without involving reasoning and both are ways in which students develop mathematical reasoning and understand mathematical ideas. In addition, evidence is a communication of reasoning that is built based on sense-making and is an important result of systematic thinking. This opinion explains that in

mathematical proof, a person either consciously or unconsciously has used reasoning to be concluded.

(Cramer-Petersen & Ahmed-Kristensen, 2016) identifies deductive reasoning as i) making definite conclusions; ii) explaining the hypothesis and its reasons; iii) predicting conformity in each formulation; iv) proving something; v) knowing the consequences of the facts and evidence produced. Mathematical reasoning is known as axiomatic deductive reasoning, meaning that deductive reasoning is based on axioms or postulates. (Carreira et al., 2020), states the following aspects of deductive reasoning. i) explain the basic structure of the interrelationships between sets to find a solution to a problem; ii) recognize the logically equivalent formulation of a statement; iii) make decisions equivalent to identifying appropriate rules; iv) draw conclusions based on certain facts and rules. By looking at these aspects of deductive reasoning, it is only natural that deductive reasoning is needed by individuals when learning mathematics.

Mathematical reasoning is known as axiomatic deductive reasoning, meaning that deductive reasoning is based on axioms or postulates. (Rodrigues et al., 2021), define the reasoning process as i) generalization, namely identifying common problems and expanding reasoning beyond its original range; ii) justification, namely providing a logical sequence of statements based on the knowledge that is known to be true to make conclusions; iii) exemplifying, namely summarizing data from the problems encountered to produce elements that will be useful in generalizing and justifying; iv) compare, namely making conclusions by considering the similarities and differences of the statements given; v) classification, namely making statements between different objects based on common characteristic identities.

In this study, indicators of deductive reasoning by Carreira (2020)(Carreira et al., 2020) in solving number theory problems are presented in table 1. below.

Table 1. Indicators of Deductive Reasoning in Solving Number Theory Problems

Indicators	Aspects
Make general statements	Explain the basic structure of the relationship between the problem and the theory to find a solution to a problem
	Recognizes the logically equivalent formulation of a statement
Make Special Statements	Making decisions is equivalent to identifying the appropriate rules
Making Conclusions	Making decisions is equivalent to identifying the appropriate rules

(Shynkaruk, 2006) argue that deductive reasoning problems are analytical reasoning in which mathematical problems can be solved based on existing information, and the solutions obtained can be verified with normal logic. Deductive reasoning is much more complex than ordinary tasks. Usually, student-teacher candidates find it difficult to make conclusions. If it is not precise in recognizing the information provided, the problem will become more difficult.

Students who are future teachers of mathematics need to learn number theory because number theory is one of the foundations of mathematics whose universal set is integers. By studying number theory, students will be able to understand arithmetic well. In number theory, it discusses proving theorems which of course require deductive reasoning. For example, if students are asked to prove that 8 is divisible by $a^2 – b^2$ if a and b are two odd numbers, then with deductive reasoning student prospective teachers will give an example a = 2k +1 and b = (2k+1)+2t with k dan t integers, $a^2 – b^2 = (2k +1) – ((2k+1)+2t)^2 = -4t2 - 4t(2k+1)=-44t(t-2k-1)$ if t is an even number then $a^2 – b^2$ is divided by 8. Based on theorem 2.2, that is “if a is divisible by a number b, then a is divisible by m times b for every integer m”. Therefore, if t is an odd number, then t-(2k+1) is an even number, so $a^2 – b^2$ is divisible by 8.

This study focuses on the deductive reasoning of prospective mathematics teacher students when solving number theory problems. This is done because previous studies have usually examined the deductive reasoning of prospective teacher students in abstract geometry or algebra material. Even though number theory is very important to be mastered by prospective mathematics teachers to deepen further mathematics material. Therefore, it is necessary to

research the deductive reasoning of prospective mathematics teacher students in this number theory material so that they can describe how the reasoning of prospective teacher students. Thus, the results of this study can be used as a reference for designing learning theories so that learning outcomes can be optimal.

B. Methodology

This research was conducted on natural and developing objects as they are. Therefore, the researcher uses a qualitative descriptive research method to describe the deductive reasoning of mathematics teacher candidates. The study was designed to give tests to two research subjects on deductive reasoning problems and to be interviewed to obtain in-depth data. The subjects in this study had the same mathematical abilities as seen from the results of the final exams at the end of the first semester and were female. The problem of deductive reasoning given to research subjects is as follows.

> The greatest common factor of two numbers is one. When added, the two numbers are divisible by an integer. What is the greatest common factor of the two numbers and their divisor?

Figure 1. The Problem of Deductive Reasoning

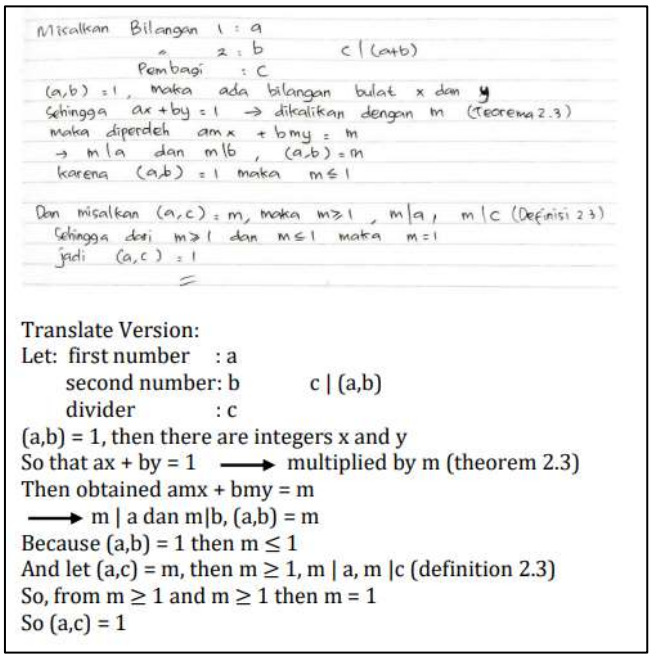
The interview used was a semi-structured interview which was conducted after the subject worked on deductive reasoning problems. The results of deductive reasoning tests and interviews and the analysis were carried out based on indicators of deductive reasoning, namely by summarizing and selecting the things needed in presenting and making conclusions about the deductive reasoning of student-teacher candidates.

C. Findings and Discussion

Findings

Descriptive Analysis

Researchers chose two research subjects, namely HNW and MAF. Data analysis in this study was carried out based on indicators of deductive reasoning. The figure 2 was the answers from the HNW and MAF subjects.



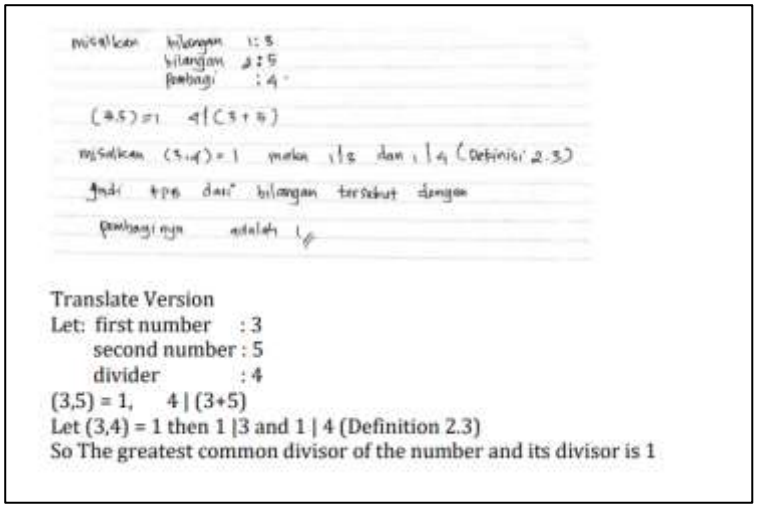
Translate Version:
Let: first number : a
second number: b c | (a,b)
divider : c
(a,b) = 1, then there are integers x and y
So that ax + by = 1 ⟶ multiplied by m (theorem 2.3)
Then obtained amx + bmy = m
⟶ m | a dan m|b, (a,b) = m
Because (a,b) = 1 then m ≤ 1
And let (a,c) = m, then m ≥ 1, m | a, m |c (definition 2.3)
So, from m ≥ 1 and m ≥ 1 then m = 1
So (a,c) = 1

Figure 2. HNW Subject Answers

The first indicator, namely making general statements with aspects of understanding the basic structure of interrelationships between sets to find a solution to a problem. Based on Figure 1. it can be seen that the HNW subjects understand the basic structure of the interrelationships between sets to find solutions to the problems given. The HNW subject wrote an example of numbers and "Theorem 2.3", this indicated that the subject understood the relationship between the problem and the theorem that had been studied. Likewise, in the results of the researcher's interview with the subject HNW, the subject said that "This problem has something to do with the theorem that has been studied, namely Theorem 2.3". The first indicator is on aspects, namely recognizing logically equivalent formulations of a statement. The HNW subject wrote "(a,b)=1, then there are integers x and y so that ax+by=1", this implies that the subject recognizes logically equivalent formulations. The HNW subject said, "I multiplied a and b by x and y and the result is equal to 1 according to theorem 2.3".

The second indicator, namely making specific statements with aspects of making decisions that are equivalent to identifying appropriate rules. In Figure 1. It can be seen that the HNW subject writes the word "then" which is associated with theorem 2.3 and definition 2.3. This implies that the subject has decided according to the rules. Likewise, with the results of the researcher's interview with the subject HNW "Based on theorem 2.3 and definition 2.3, I know that m = 1".

The third indicator with the aspect of making conclusions based on certain facts and rules. In Figure 1. It can be seen that the HNW subject has made conclusions according to the facts by writing the word "so" after analyzing the facts by writing "so that from $m \geq 1$ and $m \leq 1$ then equation when with the results of the researcher's interview with the HNW subject "when viewed from m = 1, then (a, c) = 1". This implies that the greatest common factor of two numbers and their divisor is one.



Translate Version
Let: first number : 3
second number : 5
divider : 4
(3,5) = 1, 4 | (3+5)
Let (3,4) = 1 then 1 |3 and 1 | 4 (Definition 2.3)
So The greatest common divisor of the number and its divisor is 1

Figure 3. MAF Subject Answers

The first indicator on the aspect explains the basic structure of the relationship between the problem and the theory to find a solution to a problem. MAF subjects understand the interrelationships between sets even though they don't give examples of numbers, but through examples, they write "Definition 2.3" (Figure 3). The subject said "This can see in definition 2.3" during an interview with the researcher. This implies that the subject understands the relationship between the questions and the definitions that have been studied. While the first indicator on the aspect recognizes a logically equivalent formulation of a statement, the MAF subject implicitly fulfills the second indicator by writing "for example (3,4) = 1 then 1|3 and 1|4 (definition 2.3)" and based on the results of interviews with researchers "according to definition 2.3 that if the common factor is the greatest of two numbers is one, then these numbers are divisible by one."

The second indicator of aspects of making decisions is equivalent to identifying appropriate rules. MAF subjects also make decisions by the equivalent rules, namely by writing the word

"then" and then linking it to definition 2.3. The same thing is implied from the results of the researcher's interview with the subject of MAF "The divisor is one, I get based on the definition of 2.3".

The third aspect indicator makes conclusions based on certain facts and rules. MAF subjects have also written the word "so" in making conclusions that are by the facts, namely based on definition 2.3. This is to the results of interviews between researchers and MAF subjects "I believe the greatest common factor of these numbers is one based on the definition of 2.3".

Discussion

Based on the analysis of the data, the prospective teacher students in this study fulfilled the indicators of deductive reasoning that had been determined by the researchers, even though there were differences in how to analyze them. The first prospective teacher students work with something general and relate it to theorems and definitions. This is by Lithner (2000(LITHNER JOHAN, 2000)) who states that deductive reasoning is a process of reasoning from general knowledge of principles or experience that leads us to conclude something special. On the other hand, (Cramer-Petersen & Ahmed-Kristensen, 2016) state that the mathematics teacher candidate must learn how to justify a statement that exists at three levels: doing the proof, understanding the nature of the proof, and adapting the proof of concept to different levels of development.

Meanwhile, the second student-teacher candidate works by exemplifying numbers, or it can be said that the student-teacher candidate works with something special, then relates it to the definition. This implies that prospective teacher students solve problems by using examples although, in the end, they use general things to conclusions. What these student-teacher candidates do is (El et al., 2008) statement, it can be pointed out that there are still many students at the first level of tertiary institutions who think in the concrete operational stage with inductive reasoning. There are still many students who are less able to learn mathematics by using a deductive mindset. The deductive mindset is simply said to be thinking that stems from things that are general and brought to specific things.

In addition to the things that have been disclosed by the researcher, the researcher assumes that other influences cause differences in the way prospective teacher students work on the given deductive reasoning questions, namely individual characteristics related to how to process information, store, solve problems, and how to make decisions. Of course, many factors influence it. The way individuals obtain information and process it is usually done consistently. Some individuals are global, namely, individuals who accept something globally and have difficulty separating themselves from their surroundings or are more influenced by the environment. Individuals with such characteristics are called individuals with field-dependent cognitive styles. On the other hand, some individuals are analytic, that is, they tend to describe the background of existing problems and can distinguish objects from the surrounding context and view their surroundings more analytically so that individuals who are like this are not easily influenced by the surrounding environment. Individuals with these characteristics are called individuals with field-independent cognitive styles. (Witkin & Goodenough, 1977) states that analytic individuals are individuals who separate the environment into its components, are less dependent on the environment or are less influenced by the environment. While global individuals are individuals who focus on the environment as a whole or are influenced by the environment.

Therefore, researchers provide cognitive style tests to determine individual characteristics in obtaining, storing, and processing information. This test is called the Group Embedded Figures Test (GEFT). The test results stated that the first student-teacher candidates (HNW subjects) had field-independent or analytic cognitive styles, individuals who separated the environment into its components or were less influenced by the environment. Meanwhile, the second student teacher candidate (MAF subject) has a field-dependent cognitive style, and is global or influenced by the environment. Thus, it can be said that individual deductive reasoning can also be influenced by individual characteristics in processing information or cognitive style. This is because everyone has unique reasoning characteristics, which are not shared by other individuals.

D. Conclusion

The results of this study indicate that second-semester mathematics teacher candidates reason deductively through four components, namely: explaining the basic structure, recognizing equivalent formulations, making equivalent decisions by identifying appropriate rules, and making conclusions based on facts and rules. The deductive reasoning of prospective teacher students can also be influenced by cognitive styles. In addition, the deductive reasoning of future mathematics teacher-students is a potential tool for developing logical competence in learning mathematics which will later be useful when practicing in-school mathematics learning.

Therefore, researchers suggest the importance of developing deductive reasoning for prospective mathematics teacher students so that they can easily practice it in everyday life, especially when they have entered school. In addition, to designing learning, teachers should also pay attention to individual characteristics in receiving, storing, processing information, and how these individuals solve problems so that learning objectives can be achieved.

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Analysis of the Application of STEM Approaches in Mathematics Learning in Junior High Schools

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Abstract

The integration of ICT in learning is a component of 21st-century learning. Science and technology always develop rapidly from time to time. The purpose of this study is to determine the knowledge and abilities of junior high school mathematics teachers in STEM learning. This research was also conducted to determine student knowledge related to STEM learning. This study used a mixed method. The results showed that most junior high school mathematics teachers in the Donggala district did not understand STEM/STEAM learning. The teacher has also not been able to apply the STEM/STEAM approach in the learning process. Therefore, it is hoped that mathematics teachers in the Donggala district can apply a STEAM-based approach combined with local wisdom in the Donggala district. And it is necessary to conduct training to improve teacher competencies related to STEM learning.

Keywords: *STEAM approach, ICT, local wisdom*

A. Introduction

The COVID-19 pandemic until the post-pandemic era has accelerated the integration of technology, information, and communication into the educational environment. Education in the 21st Century has become more reliant on information and commu- nication technology (Wannapiroon & Pimdee, 2022). It is also characterized by the lack of face-to-face learning

which requires teachers, especially teachers in the Donggala district to use ICT media so that they must develop their professionalism as teachers so that learning goals can still be achieved. Aykan & Yıldırım (2022) state these developments have also had ramifications on professional development, which has becom harder to achieve since the pandemic due to the lack of face-to-face learning. The advent ofnew and emerging technologies has led to the emergence ofinnovative approaches to teaching and learning aimed at cultivating the critical thinking needed for the rapidly changing and complex digital era (Meletiou-mavrotheris et al., 2022). Related to that, innovation in learning is needed so that students can develop their skills. One of the learning innovations is STEAM-based learning.

STEAM learning is contextual learning in which learners are invited to understand the phenomena in the surrounding environment, then explore in their way, and are expected to create a unique work (Sartono et al., 2020). STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning is an innovation for education in Indonesia. STEAM seeks to develop humans to be able to create something based on science and technology. With STEAM, students are encouraged to think comprehensively to try to solve problems with the five aspects of STEAM.

The STEAM-based approach combines science, technology, engineering, arts, and mathematics. Mathematics has an intimate connection to science, engineering, and arts and this connection has been even more profound with technology (Belbase et al., 2021). (Rao et al., 2021) states that true STEAM education brings together educators with expertise from very disparate fields, professional learning experiences need to create interdisciplinary spaces where meaningful, cross-disciplinary collaborations can occur. Kim *in* Aykan & Yıldırım (2022) states that some countries (UK, USA, Turkey, etc.) have integrated STEM into formal and informal education to improve science and math literacy, teach 21st-century skills, and facilitate collaboration between schools and industries. In applying this STEAM-based approach, a teacher can use the surrounding environment or local wisdom as a learning medium.

Local wisdom is substantially the norm that applies in a society that is believed to be true and becomes a reference in acting and behaving daily (Suastra & Arjana, 2021). With thousands of islands stretching from Sabang to Merauke, the Indonesian state has a lot of local wisdom. Therefore, teachers can easily apply STEAM learning combined with local context/wisdom owned by the area where they live. The learning process based on local culture and local wisdom makes it easier for students to understand the competencies in learning (Lubis et al., 2022). One area where there is a lot of local wisdom is the Donggala regency. So it is hoped that mathematics teachers in the Donggala district can apply a STEAM-based approach combined with local wisdom in the Donggala district. STEM learning directs students to think critically, collaborate well, communicate (communication), creativity to solve problems that occur in everyday life (Nurhaifa et al., 2020).

Local wisdom is a stronghold to ward off the entry of foreign culture into Indonesia, but currently, many Indonesians have abandoned local wisdom and are influenced by foreign cultures that are not by the personality of the nation, that many people have abandoned the teachings of heroes to maintain local wisdom which is the national identity of the Indonesian nation. Local wisdom is one of the characteristics of a nation in showing identity and life (Damanik & Lubis, 2022). Factors that cause this what happens is the development of technology or the digital era, in which all information is easily accessible via the internet (Rahardi, 2021). The dynamics of the times have a positive impact and also a negative in the younger generation (millennial generation), which makes it easier to access everything through the internet (Siregar & Selatan, 2022).

In summary, from this overview, the purpose of this study is to determine the knowledge and abilities of junior high school mathematics teachers in STEM learning. This research was also conducted to determine student knowledge related to STEM learningWe intend to focus on what teachers need to improve their professionalism, especially in implementing STEM-integrated ICT-based learning combined with local wisdom where teachers teach.

B. Methodology

1. *Research Design*
   The method used in this study is mixed. This method is used because this research combines qualitative and quantitative approaches in obtaining data.
2. *Instruments*
   To obtain information related to the application of the STEAM approach in mathematics learning at junior high schools in Donggala Regency, an instrument in the form of a google form is used to find out the extent of teacher and student knowledge of the application of the STEAM approach in mathematics learning. Data collection techniques in the form of surveys using google forms. The subjects of this study were 20 mathematics teachers in the Donggala district and 17 mathematics education students at Tadulako University.
3. *Technique of Data Analysis*
   The data analysis techniques used in the study are the data analysis techniques of the (Miles et al., 2014) model to analyze qualitative data and use Microsoft Excel to analyze quantitative data. The activities in the data analysis are data condensation, data display, dan conclusion drawing/verification. condensed data in the form of survey results through google forms related to teacher and student knowledge of STEM learning with local wisdom in accordance with research objectives and can provide a clear picture and make it easier for researchers to collect subsequent data, and search for it if needed. The presentation of data that has been condensed in this study is data in the form of descriptions or descriptions and if necessary will also be presented in the form of tables or diagrams. Drawing conclusions and verification is carried out after the stage of condensation and presentation of data.

C. Findings and Discussion

1. *Findings*

1.1 Analyst Results on Junior High School Mathematics Teachers in Donggala District

a. Survey related to teacher participation in STEM/STEAM learning workshops

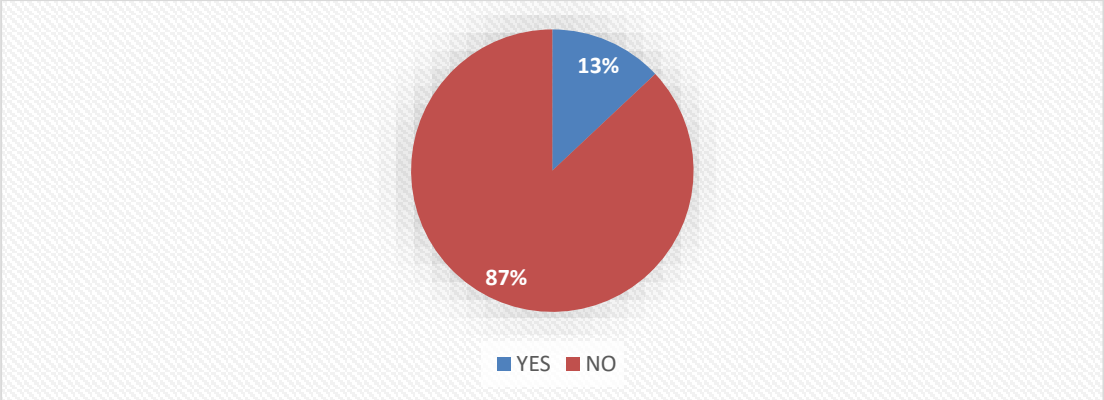

Figure 1. Diagram Of Teacher Participation In STEM/STEAM Learning Workshops

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala district, it shows that as many as 17 teachers have participated in STEM / STEAM learning workshops or as many as 85% have participated in STEM/STEAM learning workshops. Then as many as 3 teachers have not participated in STEM/STEAM learning workshops or as many as 15% have not participated in STEM/STEAM learning workshops.

b. Survey on teachers' understanding of STEM/STEAM

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that many of the teachers only know what STEM/STEAM stands for. Some state that STEM/STEAM is technology-based learning. Some state that STEM/STEAM is a learning innovation and problem solving. Some state that STEM/STEAM is knowledge and skills. Some state that

STEM/STEAM is ICT-based learning. And some claim that they don't know STEM/STEAM yet.

c. *Survey related to STEM/STEAM implementation*

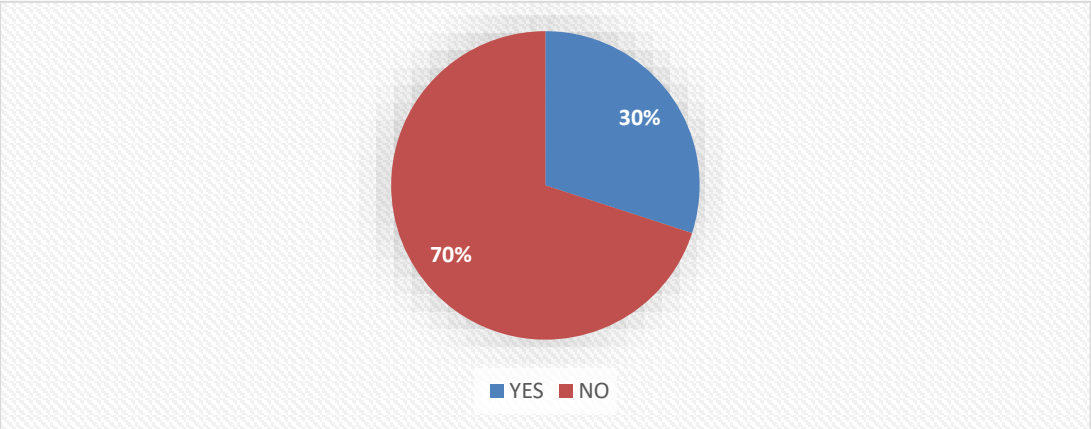

Figure 2. Diagram Of Teachers Applying STEM/STEAM Learning

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that as many as 6 teachers have implemented STEM/STEAM learning or as many as 30% have applied STEM/STEAM learning. Then as many as 14 teachers have not implemented STEM/STEAM learning or as many as 70% who have not implemented STEM/STEAM learning.

d. *Survey of obstacles faced by before and after applying STEM / STEAM learning*

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that the obstacles faced by teachers so that they have not implemented STEM/STEAM learning are because they do not know how to apply the STEM/STEAM approach. Meanwhile, the obstacles faced by teachers when implementing STEM/STEAM learning are due to inadequate electricity and networks and inadequate facilities and infrastructure.

e. *Surveys related to media / applications used by teachers when teaching mathematics*

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that most teachers use GeoGebra. There are teachers who use Desmos, Livewokrsheet, video and images, and PowerPoints. In addition, there are still teachers who have not used media / applications in teaching mathematics.

f. *Survey related to the use of local context/wisdom in learning*

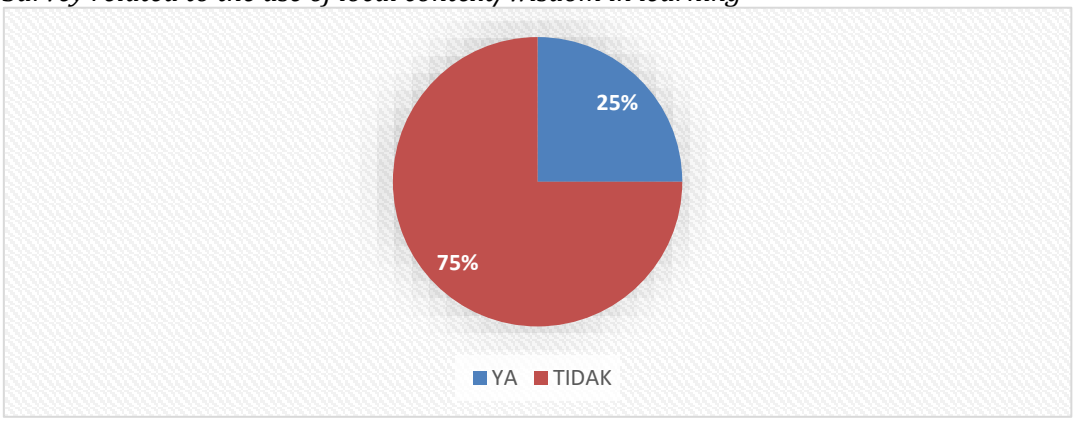

Figure 3. Diagram Of Teachers In The Use Of Local Context/Wisdom In Learning

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that as many as 5 teachers have used local context/wisdom in learning or as many as 25% have used local

context/wisdom in learning. Then as many as 15 teachers have not used local context/wisdom in learning or as many as 75% have not used local context/wisdom of learning.

g. *Local context/wisdom surveys that can be used in learning*
Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that in general teachers state that local wisdom in each region can be used in learning, such as batik bomba, sampoulo, siga, sirtu mine, Moringa leaves, and others. Furthermore, many of the teachers stated that mutual aid is a form of local wisdom that can be used in learning. In addition, there are teachers who state that culture and customs, marine resources, and the surrounding environment can be used in learning.

h. *Surveys related to training needed by teachers to improve their competence*
Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala Regency, it shows that the training needed by teachers to improve their competence is training related to improving teacher competence, especially in applying STEAM ICT learning.

1.2 Analyst Results on Students of the Mathematics Education Study Program FKIP Tadulako University

a. *Survey of student understanding related to STEM / STEAM learning*
Based on the results of a survey that has been conducted on 17 mathematics education students at FKIP UNTAD, it shows that most of them explain STEM/STEAM learning based on what STEM/STEAM stands for. In addition, there are students who do not know what STEM/STEAM learning is like.

b. *Surveys related to participation in STEM/STEAM learning*

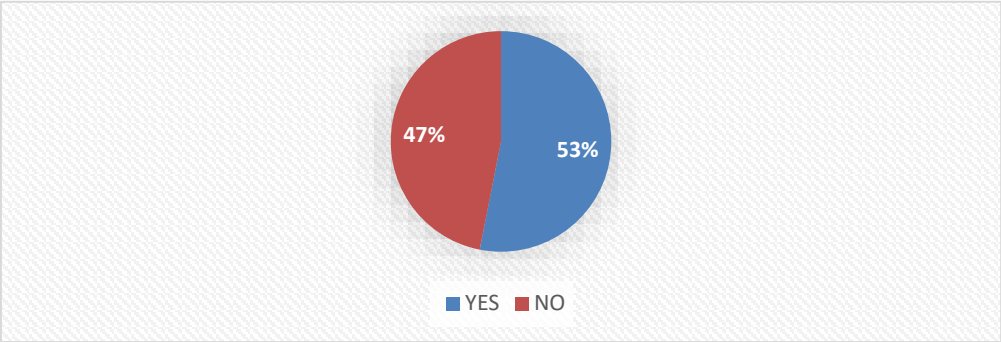

Figure 4. Diagram Of Students Participating In STEM/STEAM Learning

Based on a survey that has been conducted on 17 mathematics education students, FKIP UNTAD shows that 9 people have participated in STEM/STEAM learning or as many as 53% have participated in STEM/STEAM learning. Then as many as 8 people who have never participated in STEM / STEAM learning or as many as 47% who have never participated in STEM/STEAM learning.

c. *Surveys related to media / applications that have been used when learning mathematics*

Based on a survey that has been conducted on 17 mathematics education students, FKIP UNTAD shows that 17 people have used the GeoGebra application or as many as 100% have used the GeoGebra application in learning. Then as many as 5 people who have used Desmos or as many as 29.4% who have used the Desmos application in learning. As many as 3 people have used Nearpod or as many as 17.6% who have used the Nearpod application in learning. And no one has ever used the MathCityMap app yet.

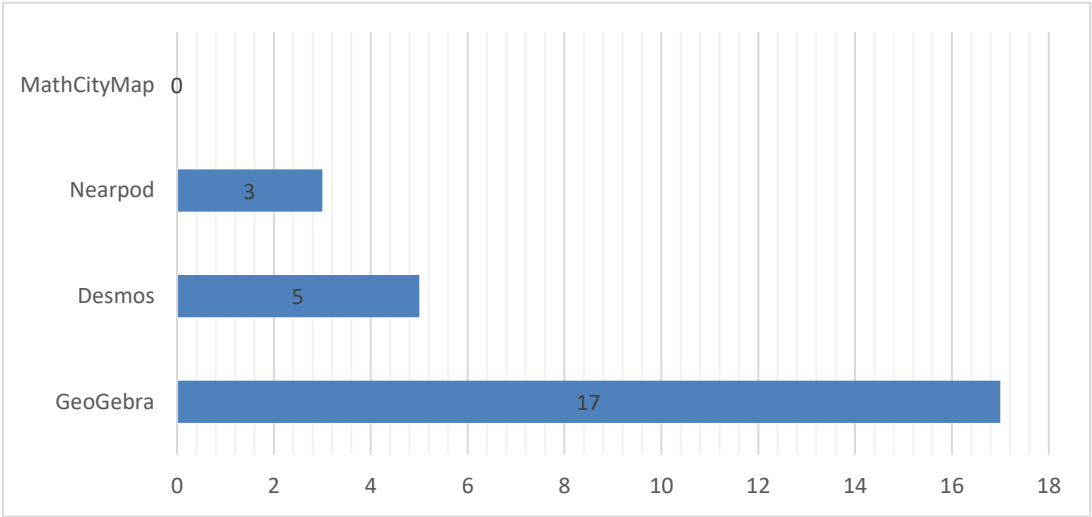

Figure 5. Diagrams Of Applications That Have Been Used While Learning Mathematics

2. Discussion

Based on the results of a survey that has been conducted on 20 junior high school mathematics teachers in Donggala district, it shows that there are teachers who are still not familiar with the STEAM approach because they have never attended a STEM/STEAM learning workshop which results in many of them not yet implementing the STEM/STEAM approach. (Morales et al., 2020) states that one that works within the bounds of Education 4.0 – necessitates quality STEAM teachers to help build STEAM-skilled citizens who are upskilled, reskilled and cross-skilled to enact STEAM curricula for global and societal needs. For this reason, trainings are needed for teachers to improve their competence so that they can become professional teachers who can create superior human beings and can be good in facing various problems. This is in line with the statement of (Mardhiyah et al., 2021) that the purpose of education is none other than to build superior human beings and can also survive in the face of various problems faced. Training and education for a sustainable future, including AI and other advanced technologies, needs special attention when it comes to minorities and underrepresented students (Skowronek et al., 2022).

Next, there are teachers who have implemented the STEM/STEAM approach even though they are not very familiar with how to apply the STEM/STEAM approach. As a result, teaching preparation is not good and the results to be achieved have not been achieved. In addition, they experience problems when applying it in learning including inadequate electricity and networks and inadequate facilities and infrastructure. In fact, to face life in the 21st-century, teachers are required to be qualified teachers to be able to innovate and characterize. This is in line with the statement of (Mardhiyah et al., 2021) that the 21st-century has very high demands to create quality human resources, these demands cause changes in the human life system in the 21st-century, so that humans in this century are required to have innovative and characteristic skills.

Then based on the results of a survey that has been conducted on 17 mathematics education students, FKIP Untad shows that many of the students can only explain STEM/STEAM by its abbreviation and some students do not understand STEM/STEAM. This is because not a few of the students have ever attended learning and workshops related to STEM/STEAM. As prospective teachers, students should prepare themselves for provisions as education staff later, one of which is by attending workshops related to education to become quality human beings, who can compete, and have skills in work. Apriliand in (Hariyanto, 2020) has explained that in this era teachers should be professional teachers, to be able to face challenges. So that by preparing from now on, students in the future can become professional teachers.

D. Conclusion

Based on the results of a survey that has been conducted on junior high school mathematics teachers in Donggala district, it can be concluded that most of these teachers do not understand STEM/STEAM learning. The teacher has also not been able to apply the STEM/STEAM approach in the learning process. Meanwhile, regarding the understanding of STEM learning, from the student side, they also do not have a comprehensive understanding. Meanwhile, Donggala Regency is one of the areas that has a lot of local wisdom that can be used as a medium in learning mathematics. However, the use of local wisdom in mathematics learning is still lacking. Furthermore, related to the application of ICT in the learning process of junior high school mathematics in Donggala district is also not optimal. Therefore, it is necessary to conduct training to improve the competence of teachers in this regard.

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Students' Mathematical Creative Thinking: A Systematic Literature Review with Bibliometric Analysis

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Abstract

This study aims to determine the trend of publications on creative thinking in mathematics learning published on Google Scholar in the 2017-2021 period, as well as describe opportunities and directions for research on creative thinking with themes related to future mathematics learning. This research is a systematic literature review study with bibliometric analysis. This research method uses PRISMA 2020 steps. The study results show that the most productive authors are Asikin, Mulyono and Tohir, each publishing two articles. The paper that gets the most citations is by Hasanah and Surya, which discusses students' creative thinking skills in mathematics using cooperative and problem-solving learning. Research themes such as students, creative thinking, problems and mathematics, and mathematical domains such as numbers, algebra and geometry have been widely used. This allows future research paths that can be studied, including the domain of mathematics in the material of statistics and opportunities, students' creative thinking in 7th and 9th-grade students gender, and the use of technological media to improve or measure students' mathematical creative thinking processes. However, the domains and topics that have been studied are still possible to be reviewed as an effort to maximize students' mathematical creative thinking abilities.

Keywords: *creative thinking, mathematics, student, bibliometric*

A. Introduction

One of the high-order thinking skills empowered in 21st-century learning is creative thinking. Creative thinking is a mental activity associated with considering new ideas, perspectives, approaches, or ways of solving problems. Creative thinking is marked by creating something new from the results of various ideas, concepts or knowledge possessed by students (Dinawati & Siswono, 2020). The development of creative thinking is needed to prepare students to face future challenges and help them solve problems while in society and the world of work (Fauzi et al., 2019; Schoevers et al., 2019).

A person's ability to think creatively is influenced by individual personality, motivation, social context, intellectual and cultural (Sternberg & Sternberg, 2012). Hilal et al., (2013) emphasized that a person's barriers to creative thinking are learning and habits, rules and traditions, perceptual and cultural, emotional, and resource barriers. Therefore, it is necessary to have practice and habits to use creative thinking skills to be more imaginative, flexible, and original in solving everyday problems. Hayes states that creativity can be increased by developing basic knowledge, creating the right atmosphere for creativity and looking for analogies (Solso et al., 2014).

Creative thinking is distinguished from other types of thinking because creative thinking generates new and original ideas or solutions to problems. Creative thinking refers to the originality and uniqueness of ideas or solutions that did not exist before. Wallas (Solso et al., 2014) explains that there are 4 stages in the creative process: preparation, incubation, illumination and verification. Preparation is done by formulating a problem and making an initial effort to solve it. Incubation is the period when no effort is made directly to solve the problem and attention is momentarily diverted to something else. Illumination is gaining insight (deep understanding) of the problem. Verification is testing the understanding that has been obtained and making solutions.

Creative thinking can be trained through learning mathematics (Sternberg in Choifah et al., 2022). The ability to think creatively in learning mathematics is the ability to express ideas creatively in solving mathematical problems. The ability to think creatively mathematically is a way of thinking that is measured through thinking fluency, thinking flexibility, thinking originality, and elaboration. Fluency is shown by the ability of students to express more than one idea to solve problems, ask lots of questions that show mastery of the material, and give many suggestions that might be solutions to problems. Flexibility is shown by the ability of students to see a problem from many different perspectives and then find alternative strategies for solving approaches and ways of thinking. Originality is a person's ability to think uniquely to produce new thoughts that may not be commonplace, although the truth still needs to be tested. Elaboration is shown by students' ability to parse again, and develop existing ideas in more detail to become a more complete and interesting unit of thought (Septiani et al., 2018). Mathematical creative thinking can help students devise various solutions to a problem. Therefore, students need to have the ability to think creatively and mathematically.

The fact is that there are still many junior high school students who have relatively low mathematical creative thinking abilities (Buyung, 2021). Cahyani et al., (2019) stated that students' creative thinking was low because the teacher only gave routine questions. Teachers do not provide creative thinking practice questions to students, so students are not familiar with mathematical creative thinking skills questions (Hudanagara & Anita, 2018). Students think less/not creatively because students find it difficult to understand problems (Siregar et al., 2018) and have low mathematical abilities (Febrianingsih, 2022). In addition, students are more likely to enjoy learning with almost the same questions, so students have difficulty generating new solutions (Pasaribu, 2020).

Arifah & Asikin (2018) argued that students' low creative thinking skills were influenced by several factors, one of which was the learning process. Several other studies have provided alternative solutions to improve junior high school students' creative thinking skills by applying appropriate learning models/approaches. Students' mathematical creative thinking increases

after applying open-ended learning (Cahyani et al., 2019; Utami et al., 2020). The ability to think creatively and mathematically develops after learning with a problem-posing approach (Lutfi, 2016; Setiyani, 2020). The ability to think creatively mathematically increases after learning using the Search, Solve, Create and Share learning model (Sujiarto & Sukmiati, 2017). There is also an increase in the average ability of students to think creatively mathematically after being taught contextual mathematics learning (Ruhiyat & Sugandi, 2017) and realistic mathematics education (RME) approach (Utami & Ilyas, 2019).

In addition, some research on creative thinking is also related to other mathematical hard skills or soft skills. Creative thinking influences self-confidence and self-efficacy (Septiani et al., 2018), mathematical disposition (Ruhiyat & Sugandi, 2017), problem-solving (Desti et al., 2018), and mathematics learning outcomes for junior high school students (Sahwari & Dassucik, 2021). Dinawati & Siswono (2020) states that math anxiety harms junior high school students' mathematical creative thinking.

The study of mathematical creative thinking has been studied and contributed to various aspects of research, a literature review related to mathematical creative thinking is needed further to strengthen the relevance of learning mathematics. A literature review on research themes related to students' creative thinking in learning mathematics can be done using bibliometric analysis. Bibliometric analysis is needed to update research information in mathematics education (Julius et al., 2021). The results of our search, research on bibliometric analysis for the term creative thinking in mathematics, has only been carried out by (Rahayu et al., 2022). Rahayu used Google Scholar data sources in the 1957-2020 range in his research. Researchers need to conduct a bibliometric analysis to reveal more about the trend of creative thinking in mathematics, especially in recent years. The purpose of this study is to find out the trend of publications on creative thinking in mathematics learning which are published on Google Scholar in the last 5 years (authors, articles and themes) and to describe opportunities and directions for research on creative thinking with related themes in learning mathematics in the future.

This research can be a reference and starting point for other researchers who are interested in research on creative thinking in learning mathematics. The results of this study can provide knowledge and experience to see opportunities for research trend trends in finding novelty and avoiding repetition of research in the future.

B. Methodology

This research is a systematic literature review (SLR) study. SLR was performed by bibliometric analysis. Bibliometric analysis is one of the literature's most detailed and intelligent data research. This subject review is directed at literature material by applying numerical and measurable strategies (Karim & Soebagyo, 2021). Bibliometric analysis is often carried out as part of a systematic review because it can clarify information regarding the progress of knowledge creation based on quantitative metrics of scientific production (Oliveira et al., 2015). Therefore, bibliometric analysis can be used to reveal emerging trends in articles and journals.

This research method uses the steps in Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 for databases and registers (Haddaway et al., 2022). The steps consist of: (1) identifying the topics for relevant studies; (2) screening documents; and (3) including the documents for analyzing, synthesizing, and describing studies. Searching and selecting articles through the PRISMA steps is presented in Figure 1.

The identification step is carried out by searching for the article's title from the Google Scholar database using the Publish or Perish (PoP) software, which includes the keyword "creative thinking in mathematics". This research focuses on articles and proceedings published in English, national and international, with publications ranging from 2017 to 2021. Search results based on keywords obtained 121 articles. There were 21 articles removed because 4 were duplicate articles and the others were not articles but research statements (type citations). After a sample of 100 articles has been determined, the next step is screening.

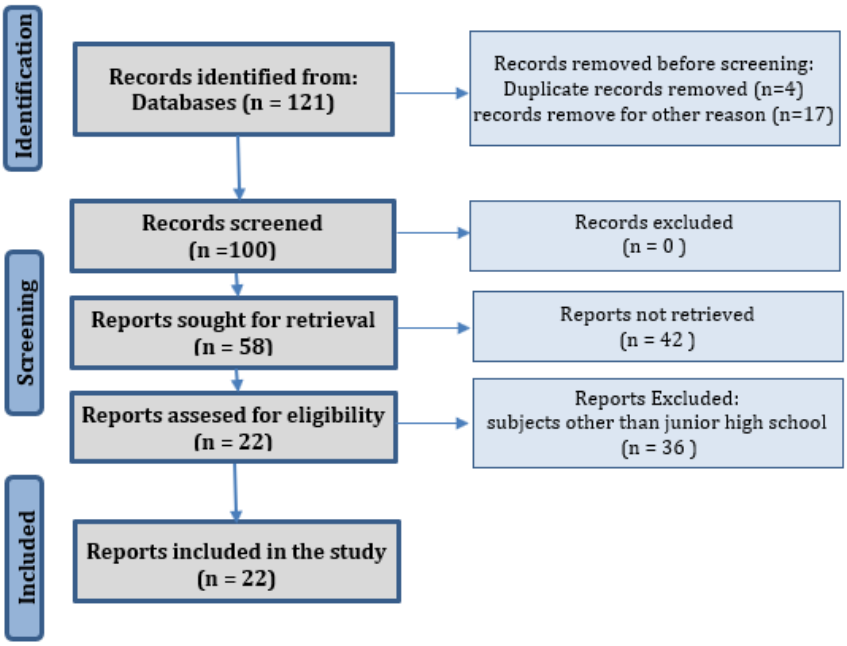

Figure 1. PRISMA flow diagram

In the screening application, all titles were relevant, it was sought to retrieve articles per the research objectives, resulting in a sample of 58 articles (articles issued were articles other than Indonesia). After verifying suitability with the specified theme, 22 articles were obtained following the subject to be studied, namely junior high school students. The main reason for the other articles being excluded is because the subjects of the articles are elementary, high school, vocational and university students. Thus, the results of selecting articles at this stage were 22 articles because they met the two predetermined criteria.

The selected articles are then saved in CSV and RIS formats. CSV is used to process table and graphic data that provides information on the title, author's name, journal name, year of publication and number of article citations. Meanwhile, RIS was used for bibliometric analysis using VOSviewer software. VOSviewer can do mapping in creating different co-authorship and co-occurrence of keywords. VOSviewer visualization provides data representation through network visualization, overlay visualization and density visualization. Network visualization presents linkages and research theme clusters related to keywords. Overlay Visualization is used to identify the year of implementation of related research themes. Density visualization is used to analyze research themes that are frequently and rarely researched.

C. Findings and Discussion

1. Number of Publications

The search results for "creative thinking in mathematics" document data for junior high school students in Indonesia show that there were as many as 22 research documents in the 2017-2021 period. The number of articles published during this period is presented in Figure 2.

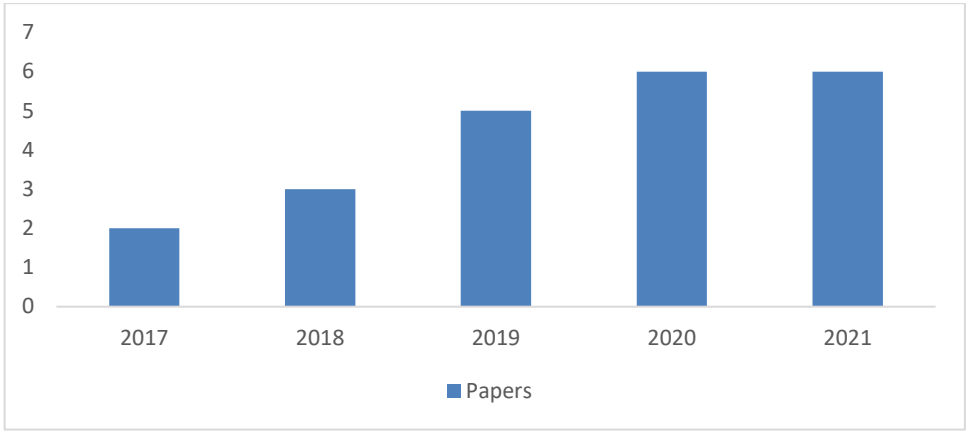

Figure 2. Total of creative thinking in mathematics articles in 2017-2022 (n=22)

The number of papers per year is presented in Figure 2. which shows that the number of papers has increased in the last five years. In 2017 there were 2 articles; in 2018, there were 3 articles; in 2019, there were 5 articles; in 2020, there were 6 articles; in 2021, there were 6 articles.

2. The most productive authors and articles

After the RIS data was entered into the VOSviewer software, 41 authors were obtained, with authors who had at least 2 documents found 3 authors. The network visualization of these findings is presented as shown in Figure 3.

Figure 3. Network visualization of co-author. Source: VOSviewer

Figure 3 shows that the network does not have interconnected lines with the same magnitude. This shows that the contribution of the three authors regarding mathematical creative thinking is similar to each of the 2 articles. Askin's article discusses the quality of mathematics learning settings challenge-based learning on student's creative thinking skills and belief in math (Ardiansyah et al., 2018) and describes student's creative thinking skills viewed by adversity quotient and mathematics anxiety (Wahyuningtyas et al., 2020). Mulyono, in his article, examines students' mathematical creative thinking skills based on field-independent and field-dependent cognitive styles (Yulianto et al., 2021) and the effectiveness of the MiC learning model with an open-ended approach to mathematical creative thinking ability (Dwidayati et al., 2020). Tohir discusses students' creative thinking skills in solving math Olympiad problems based on

metacognition levels (Tohir, 2019) and students' creative thinking skills in solving Olympic problems Based on Problem-Solving Polya and Krulik-Rudnick Models (Tohir et al., 2018).

The selected articles were also analyzed for the number of citations per paper to determine which articles were the most productive. The number of paper citations is shown in Table 1 below

Table 1. Total Number of paper citations

Author	Judul	Quantity	Frequency(%)
Hasanah & Surya (2017)	Differences in the Abilities of Creative Thinking and Problem Solving of Students in Mathematics by Using Cooperative Learning and Learning of Problem Solving	103	35,4
Maharani, et al. (2017)	Creative Thinking Process based on Wallas Model in Solving Mathematics Problem	57	19,59
Tohir et al. (2018)	Students' Creative Thinking Skills in Solving Mathematics Olympiad Problems Based on Problem-Solving Polya and Krulik-Rudnick Model	33	11,34
Ardiansyah et al (2018)	Student's Creative Thinking Skill and Belief in Mathematics in Setting Challenge-Based Learning Viewed by Adversity Quotient	25	8,59
Sari et al. (2018)	The development of learning instruments using the creative problem-solving learning model to improve students' creative thinking skills in mathematics	21	7,22
Sya'roni et al. (2020)	Students' creative thinking skills in the flipped classroom-blended learning of mathematics based on lesson study for learning community	14	4,81
Wahyuningtyas (2020)	Student's Creative Thinking Skills Viewed by Adversity Quotient and Mathematics Anxiety in Grade VIII	9	3,09
Tohir (2019)	Students' Creative Thinking Skills in Solving Mathematics Olympiad Problems Based on Metacognition Levels	9	3,09
Hidajat (20201)	Students' Creative Thinking Profile as a High-Order Thinking in the Improvement of Mathematics Learning	5	1,72
Samura et al. (2021)	Improving the Creative Thinking Ability of Junior High School Students Through GeoGebra Assisted Learning Community in Mathematics	4	1,37
Bahrudin & Siswono (2020)	Mathematics Anxiety and Students' Creative Thinking Process in Solving Number Patterns Problems	4	1,37
Mellawaty et al. (2019)	Creative thinking ability on the integrating mathematical habits of mind in Missouri mathematics project learning	3	1,03
Muttaqin et al. (2021)	Students' creative thinking skills in solving mathematics higher order thinking skills (HOTS) problems based on online trading arithmetic	2	0,69
Pratama & Budiarto (2017)	Creative Thinking Ability Of Students In Grade VIII JHS To Solve Higher Order Thinking Problem Considered by Mathematics Ability	2	0,69
Total		**291**	**100**

Table 1 presents the 14 papers cited on creative thinking in mathematics. The most cited paper is Hasanah & Surya (2017) paper, with 103 citations (35,4%). The next paper is Maharani et al. (2017) paper, with 57 citations (19,59%), Tohir et al. (2018) with 33 citations (11,34%), Ardiansyah et al. (2018) with 25 citations (8,59%), Sari et al. (2018) with 21 citations (7,22%) and Sya'roni et al. (2020) with 14 citations (4,81%). Other papers get citations under 10 citations. Citation trends will continue to increase in line with the level of publication. This addition is expected to continue because research on creative thinking in learning mathematics is a field of research that is enough to increase the interest of researchers. Many issues can be studied further to develop processes or provide alternative solutions to improve creative thinking abilities and skills in learning mathematics.

3. Clusters, Themes and Future Research

Based on cluster analysis using the binary calculation method, 80 terms appear. Only 70 items are connected with 11 clusters and 251 links. The network visualization display is presented as shown below.

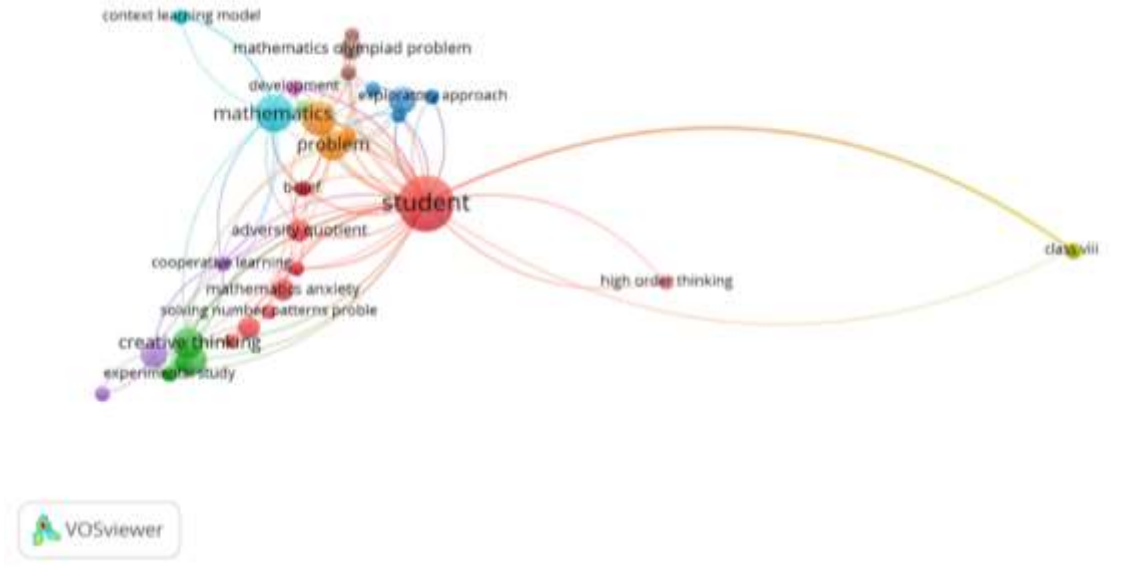

Figure 5. Network Visualization of Co-occurrence. Source: VOSviewer

The results of the network visualization show that there are items with larger nodes so that they are more clearly visible from other items. These nodes are student (cluster 1, shown in red), creative thinking (cluster 2, shown in green), mathematics (cluster 6, shown in turquoise) and problem (cluster 7, shown in orange). The big node illustrates that students, creative thinking, problems and mathematics are widely studied simultaneously. This is possible because in this study, the subjects used were students. Likewise, creative thinking is a keyword because it is the central theme used in this study. Creative thinking is a mental activity used when students want new ideas. Creative thinking allows one to produce several solutions to solve problems (Bahrudin & Siswono, 2020). Creative thinking can be developed and trained through learning mathematics. Based on this, it indicates that problems and mathematics are important parts of creative thinking.

The following shows the occurrence data with the author's keywords with an overlay visualization in Figure 6.

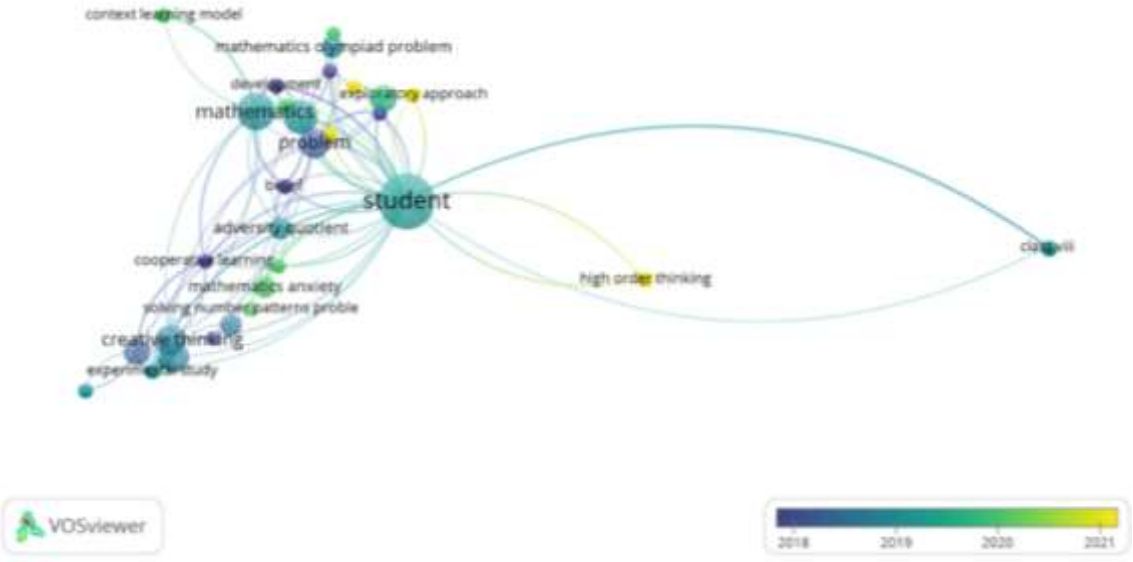

Figure 6. Overlay Visualization of Co-occurrence. Source: VOSviewer

In Figure 6, the student item overlay network has the most connections. Student, creative thinking, and mathematics items were widely published between 2018-2020. The problem item was made the centre of research in 2018. The yellow colour is the item with the latest publication (in 2021), namely high-order thinking skills, explanatory approach and the use of GeoGebra.

Density Visualization of the Co-occurrence of creative thinking in mathematics can be seen in the distribution in Figure 7 below.

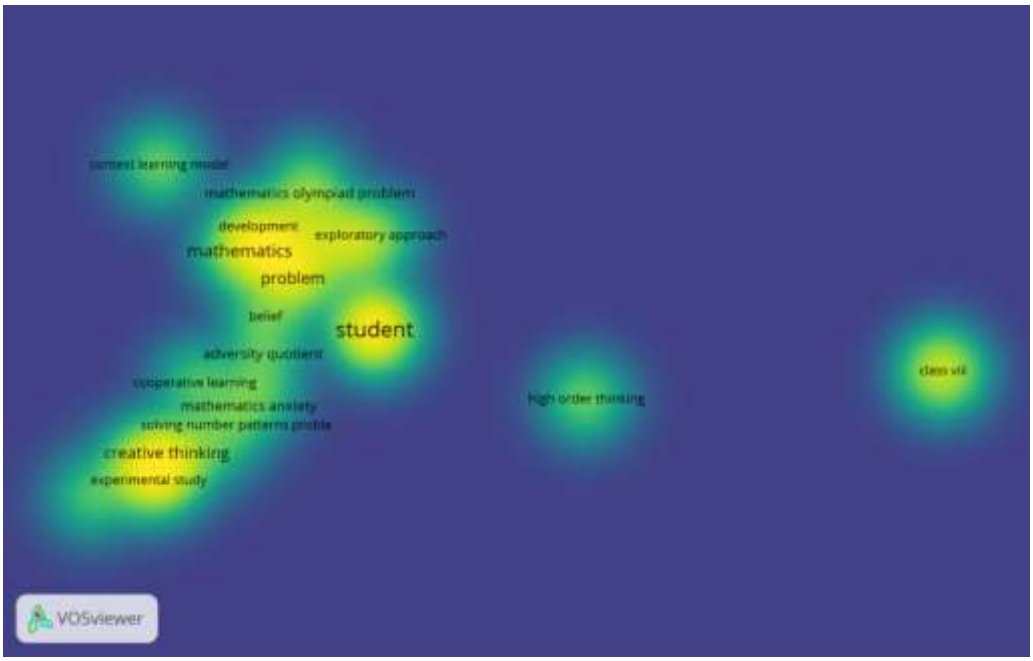

Figure 7. Density Visualization of Co-occurrence. Source: VOSviewer

Figure 7 shows that student, creative thinking, problem and mathematics items have the brightest light. This shows that these themes are widely used in research on creative thinking mathematics in junior high school students in Indonesia. While other themes such as experimental study, explanatory approach, class VIII, high order thinking, belief, mathematics anxiety, solving number patterns, cooperative learning, development and adversity quotient are still little researched and can be developed into future research to support the ability to think creatively mathematically student.

The visualisation results show that most previous research focused on 8th grades students. Furthermore, it can be studied further related to the ability to think creatively in 7th and 9th-grade students. It can even be explored further by considering the gender differences. Research on students' creative thinking still needs to be improved in involving technology. Some of the technology applications used include flipped classroom-blended learning (Sya'roni et al., 2020), the use of GeoGebra (Samura, 2019) and online trading arithmetic (Muttaqin et al., 2021). Therefore research is needed regarding developments in media-related technology or tools to improve or measure students' mathematical creative thinking processes or skills.

In the content analysis of the article, information was also obtained that the content domains discussed were numbers, algebra, and geometry. Some specific materials from numbers, algebra, and geometry have been studied to review students' creative thinking processes. The materials used include number patterns (Bahrudin & Siswono, 2020), social arithmetic (Dwidayati et al., 2020), relations and functions (Sya'roni et al., 2020), algebraic operations (Yulianto et al., 2021), circles (Hasanah & Surya, 2017), triangles (Mellawaty et al., 2019), and the volume of flat side space (Ardiansyah et al., 2018). Domains that are still limited to research are statistics and probability. Statistics and probability can be studied as future research by considering the learning approach and student character. Research conducted by Fadlilah et al. (2021) showed that students with a visual learning style were more creative than those with a visual-kinesthetic

learning style in solving statistical problems. However, the previously researched domains and topics are still worthy of being considered for review as an effort to maximize students' mathematical creative thinking abilities.

D. Conclusion

A systematic literature review through bibliometric analysis was conducted to provide a reliable, consistent and up-to-date review of research on creative thinking in mathematics learning. Specifically, an analysis of the co-authorship and co-occurrence of keywords was performed, followed by an in-depth analysis of 22 documents published between 2017 and 2021. This review offers a comprehensive overview of creative thinking in mathematics learning. The review describes the research publication trends of the last 5 years (authors, articles and themes), thus forming the basis for offering possible future research pathways. The findings show that the number of research papers on creative thinking in mathematics learning increased in 2017-2021. The most productive authors then were Mohammad Asikin, Mulyono and Mohammad Tohir who each published 2 articles. The most influential paper on creative thinking research is by Hasanah and Surya, which states that STAD is better than problem-solving learning in increasing students' creative thinking with 103 citations. Research themes such as student, creative thinking, problem and mathematics, and mathematical domains such as numbers, algebra and geometry have been widely used in research on creative thinking mathematics among junior high school students in Indonesia. This allows future research paths that can be studied, including the domain of mathematics in the material of statistics and probability, creative thinking in 7th and 9th-grade students, gender, and research related to technological developments related to media or tools to improve or measure students' mathematical creative thinking processes or skills. However, apart from this, the domains and topics that have been previously researched are still worthy of consideration and are being reviewed again to maximize students' mathematical creative thinking abilities. Therefore, this study can guide researchers and contribute to developing research on creative thinking in learning mathematics.

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The Improvement of Mathematics Learning Outcomes with Think Pair Share Cooperative Learning Model

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Abstract

In the process of mathematics learning, many students are less active, many are noisy, the work given is not completed, and the results of student evaluations are not satisfactory. For this reason, appropriate learning improvements are needed, namely by applying the think pair share cooperative learning model. This study aims to improve mathematics learning outcomes through think pair share cooperative learning method (think, pair, share) for Marsudirini Perawang elementary school students. The research subjects were students of grade 3 (three) totaling 30 people. The type of research is classroom action research. The research procedure consisted of planning, implementing actions, observing, and reflecting. The research instruments are learning tools and data collection tools (test sheets and student observation sheets). The results showed that the students' scores had increased very well from 0% then 10% to 26%. In the daily test score of 1, the number of students who achieved the very good category increased by 10%. Meanwhile, in the daily test score of 2, the number of students who achieved the very good category increased to 26%. The average score of students on the second daily test increased above the minimum completeness criteria (KKM) that had been determined by the school (73>70). Student activities in the aspects of answering questions, discussing student worksheets and reporting discussion results have increased. In the first cycle the average was 17.3% and 35.3%. While in the second cycle it rose to 53% and 73.3%. Overall, the average student activity in the first cycle was 18.12% and in the second cycle 63.33%. Thus, the application of think pair share cooperative learning model can improve mathematics learning outcomes in grade 3 (three) elementary school students.

Keywords: *Mathematics, Learning Outcomes, Think Pair Share Cooperative Learning*

A. INTRODUCTION

The main objective of learning in elementary school is the ability to write, read and count. This shows that learning mathematics in elementary schools is very important. Especially in lower grades learning mathematics is a provision of basic skills to study other subjects as well as higher knowledge. The main purpose of learning mathematics is to understand mathematical concepts, explain the interrelationships between concepts and apply concepts or algorithms, flexibly, accurately, efficiently and precisely in problem solving, use reasoning on patterns and properties, perform mathematical manipulations in making generalizations, compiling evidence or explaining ideas. and mathematical statements, solving problems which include the ability to understand problems, design mathematical models, complete models and interpret solutions obtained, communicate ideas and symbols, tables, diagrams or other media to clarify situations or problems, have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention and interest in learning mathematics as well as a tenacious and confident attitude in solving problems (Depdiknas, 2004).

Mathematics is so important for elementary school students, but in fact at Marsudirini Perawang elementary school, especially grade 3 where the author teaches many students who do not like learning mathematics. When learning mathematics, many students are not active in learning, remain silent when asked to answer questions or are asked to ask questions by the teacher and only smart students do the whiteboard assignments, rarely ask if there is something they do not understand and the evaluation results are not in accordance with which is expected. Symptoms that often appear during the mathematics learning process are caused because the teacher only provides opportunities for smart students to work on questions on the blackboard and do not involve all students in turn in the learning process. Seeing this condition, the teacher certainly did not let this problem drag on because it greatly affected the mathematics learning outcomes of the 3rd graders of Marsudirini Perawang elementary school.

In the student learning process, it is stated that learning outcomes are the abilities students have after receiving their learning experiences. Meanwhile, (Sagala, 2005) states that the learning outcomes changes in behavior due to the learning process for individuals or the final value of the learning process carried out by adults consciously. And these learning outcomes reflect the breadth and depth and complexity of competencies formulated in knowledge, behavior, skills, attitudes and values that can be measured by various assessment techniques (Kurikulum, 2006). Based on these statements, it can be concluded that learning is a process of change in the human personality so that behavior changes due to experience and practice.

There are several factors that affect a person's learning outcomes, some of which according to (Syah, 2007) are as follows: Internal factors, these factors are factors from within students. As for what is included in this factor is health, disability, psychology which includes intelligence, interests, talents, maturity, and readiness; External factors, these factors are things that come from outside the individual, including family conditions, economic conditions, as well as environmental and school conditions; The learning approach factor, this is a type of student learning effort that includes the use of strategies and methods used to carry out learning activities.

Cooperative learning is not something new. In cooperative learning, students are formed in groups of 4 or 5 people to work together in mastering the material given by the teacher (Slavin, 2005). Cooperative learning is where students learn together as a team in completing group tasks to achieve common goals. So each group member has equal responsibility for the success of the group.

During cooperative learning, students stay in their groups for several meetings. They are taught special skills in order to work well in their groups, such as being active listeners, giving good explanations to their group mates, discussing, and so on. To be carried out well, students are given an activity sheet containing questions or assignments that are planned to be taught. While working in groups, the task of group members is to achieve completeness of the material presented by the teacher and help each other among group friends to achieve material

completeness. Learning has not been completed if one of the group members has not mastered the subject matter.

(Zamroni, 2000) suggests that the benefit of implementing cooperative learning is that it can reduce educational disparities, especially in the form of input at the individual level. In addition, cooperative learning can develop social solidarity among students. With cooperative learning, it is hoped that in the future a new generation will emerge who have brilliant academic achievements and have strong social solidarity. Cooperative goal structure occurs when students can achieve their goals only if other students with whom they work together achieve these goals.

Slavin (1995) in (Huda, 2011) states the purpose of cooperative learning is to maximize student learning to increase academic achievement and understanding both individually and in groups. Because students work together in a team, it automatically improves relationships among students from various ethnic backgrounds and abilities, develops group process skills and problem solving (Luisell & Descamps in (Huda, 2011). From several variations in the cooperative model the author take the Think Pair Share model or think in pairs. Sharing is a type of cooperative learning designed to influence student interaction patterns. Think Pair Share can give students more time to think, to respond and to help each other. Based on this theoretical study that by thinking (Thinking), in pairs (Pairing), discussing and reporting (Sharing) can help students to respond and help each other (Suyatno, 2009). In connection with the Think Pair Share method giving students more time to think (Thinking), sitting in pairs (Pairing), responding and helping each other (Sharing) with learning outcomes, the hypothesis of action in this study is if by giving students more time to think (Thinking), sitting in pairs (Pairing), responding and helping each other (Sharing) can be applied in learning mathematics, then the mathematics learning outcomes of 3rd grade students of Marsudirini Perawang elementary school will increase.

Here are some results of classroom action research using the Think Pair Share model of cooperative learning:

No.	Writer	Research Title	Research Result
1	(Marta, 2017)	Improving Mathematics Learning Outcomes With Think Pair Share Type Cooperative Models in Elementary Schools	Learning outcomes in the first cycle are still relatively low with a mean of 73.75. Furthermore, out of 20 students, only 13 students completed while completing 65% classical learning. And the learning outcomes in the second cycle are classified as very good with an average of 84.25, and 20 students there are 17 students who complete while completing 85% classical learning. Thus, using the Think Pair Share (TPS) type model can improve mathematics learning outcomes in simple class IV building materials at SDN 009 Sialang Kubang
2	(Yuliyanti & Harini, 2019)	The Effect of TPS (Think Pair Share) Model on Mathematics Learning Outcomes of Fourth Grade Students at SDN Sindurejan	The results of the significance analysis of 0.000 <0.05 have a positive and significant effect on the use of the TPS (Think Pair Share) learning model on mathematics learning outcomes. So there are significant differences in learning outcomes of mathematics using the TPS (Think Pair Share) learning model and conventional methods. By looking at the average learning outcomes using the TPS (Think Pair Share) learning model is 65.282 and those using the conventional method are 49.935.
3	(Litna & Seli, 2019)	Application of the Think-Pair-Share (TPS) Cooperative	Obtained through interviews, observations and tests. The subject of the study was the fourth grade elementary school, which consisted of 20

		Learning Model to Improve Mathematics Learning Activities and Achievements	students. Based on the data analysis that has been done, the average student learning activity in the first cycle is 37.67 in the moderately active category, then increased in the second cycle to 53.83 with the active category. The results of student achievement in the first cycle was 62.65, increasing to 76.2 in the second cycle. Thus, the results of this study indicate that the application of the think-pair-share (TPS) cooperative learning model can increase students' learning activities and achievement in mathematics.
4	(Dewi et al., 2019)	Efforts to Improve Mathematics Learning Outcomes Through Think Pair Share (TPS) Learning Models Assisted by Media Build Class IV Elementary School Creations	The results showed an increase in student learning outcomes from the initial conditions that reached KKM only 32%, then in the first cycle it increased to 73% and in the second cycle it increased again to 91%. This increase occurred because students began to understand concepts in mathematics learning using the Think Pair Share (TPS) learning model with the Build Creative media and students became more enthusiastic, active, and creative in participating in the teaching and learning process.
5	(Khamid, 2014)	Improving Mathematics Learning Outcomes Through Think Pair Share in Class VI SD Negeri Jetis 1 Yogyakarta	The results of this study indicate that the implementation of the learning model Think Pair Share cooperative type there is an increase in cycle I obtained the average value of the class is 76.34, the second cycle the average value of the class is 80.77, and in the third cycle obtained an average grade of 90.19. Through TPS, students have felt that this thinking activity does require the knowledge of each, students are able to work in groups and agree on the results, and take responsibility for the results in front of the class.
6	(Hamdan, 2017)	The Effect of (Think – Pair – Share) Strategy on the Achievement of Third Grade Student in Sciences in the Educational District of Irbid	The findings of the study show that there are statistically differences in grades of students due to group variable at the significance level (0.05), and the differences were in favor of the experimental group and there are statistically differences due to gender at the significance level (0.05) in favor of females.The study recommended to entry (Think – Pair – Share) strategy within the teaching strategies used by students during the teaching and the involvement of teachers in training courses on (Think – Pair – Share) strategy.
7	(Manurung, 2017)	Using Think-Pair-Share To Improve Speaking Achievement Of The Second Semester English Study Program Of	The results showed that the average score of students speaking achievement was 66 in cycle I and the observation result was 62.82. The result had not been reached the target yet that was >70. At least more than 85% students could achieve the score above 70. Thus, cycle II was necessary to be implemented. In cycle II, the average score

		Tridinanti University Palembang	of speaking test was 81 and the observation result was 81.06. The students had reached the target and the cycle was stopped. In conclusion, the implementation of TPR had brought significant improvement to the students speaking achievement.

Mathematics is so important for elementary school students, but in fact at Marsudirini Perawang elementary school, especially grade 3 where the author teaches many students who do not like learning mathematics. When learning mathematics, many students are not active in learning, remain silent when asked to answer questions or are asked to ask questions by the teacher and only smart students do the whiteboard assignments, rarely ask if there is something they do not understand and the evaluation results are not in accordance with which is expected. Symptoms that often appear during the mathematics learning process are caused because the teacher only provides opportunities for smart students to work on questions on the blackboard and do not involve all students in turn in the learning process. Seeing this condition, the teacher certainly did not let this problem drag on because it greatly affected the mathematics learning outcomes of the 3rd graders of Marsudirini Perawang elementary school.

B. METHODOLOGY

In this Classroom Action Research, researchers collaborate with colleagues as observers of the research process, it is highly expected that high honesty is needed to provide information, input and ideas so that researchers can take further action efforts in improving student learning outcomes. Likewise, the support and guidance of the principal in the implementation of this research. So that Classroom Action Research conducted by researchers can run well and smoothly.

1. *Research Subject*
   The subjects of this study were 3rd grade students of Marsudirini Perawang elementary school, totaling 30 students. The research topic is improving mathematics learning outcomes in time unit material (hours) by applying the Think Pair Share (TPS) Cooperative learning model. Thus, the implementation of the learning improvement actions was carried out in grade 3 Marsudirini Perawang elementary school. In the implementation of this research, it was carried out in two cycles, cycle 1 on October 8th 2018 and cycle 2 on October 15th 2018 for mathematics subjects.
2. *Learning Improvement Procedure Design*
   This research is classroom action research (CAR), which is an action or effort of the teacher in the learning process through self-reflection with the aim of improving so that student learning outcomes increase (Aqib & Dkk, 2009). This learning improvement effort is called a cycle. Classroom action research has four components, namely planning, implementation, observation, and reflection (Wardani, 2010).

Cycle I

a. Action plan

1. Cycle I corrective actions will be implemented in grade 3 MarsudiriniPerawang elementary school on:
   a. Meeting 1: Monday, October 8th, 2018
   b. Meeting 2: Thursday, October 11th, 2018
2. Learning equipment prepared by lesson plans, worksheets, and wall clocks.
3. Determining pairs, smart students with students who are less able to take lessons.

b. Action execution

1. Initial Activity (10 minutes)
   1. The teacher starts learning by giving apperception and motivation to students.
   2. The teacher conveys the learning objectives to the students.
2. Core Activities (45 minutes)
   1. The teacher asks students to sit in pairs, who are smart with students who are less able to follow the lesson.

2. The teacher shows the picture of the clock to the students and explains how to read the time signs on the clock.
3. Students practice turning the long and short needles according to the time determined by the teacher alternately in front of the class.
4. The teacher distributes student worksheets
5. Students discuss the questions given by the teacher on the worksheet with their partner.
6. Students report the results of their group work to the pairs in the class.

3. Final Activity (15 minutes)
    1. Students conclude the lesson guided by the teacher
    2. Students work on evaluations with teacher supervision.

c. Observation / observation

1. The things observed by observers are as follows:
   Teacher Activities:
    1. In motivating students the teacher does not provide examples that exist in the student environment.
    2. The teacher is too quick to speak at the time of apperception.
    3. In class management, the teacher informs the smart students' assignments.
    4. The teacher only supervises some students at the time of study.
    5. The teacher guides students to conclude that the lesson still dominates.

   Student Activities:
    1. Students are not well motivated.
    2. Only some students can relate apperception to the subject matter.
    3. Smart students have not been able to guide their partner in learning well.
    4. Some students are still noisy in learning.
    5. Only smart students can answer questions from the teacher.
    6. Students are generally excited to do the exercise in pairs.
    7. Some students still do not summarize the subject matter.

d. Reflection

After the data is obtained and has been discussed by peers, by analyzing the weaknesses and strengths of the teacher in teaching in the planning of the first cycle, then the planning of the second cycle will add the following actions:

1. The teacher must improve the way of speaking in conveying motivation, apperception, and giving examples that are commonly known to students in their environment.
2. Teachers must supervise students as a whole in learning.
3. Teachers should involve students more in learning.

Strength to be improved:

1. Determination of partners, preferably closer friends so that they can more easily communicate in learning.
2. The use of props will be added with a variety of clock models, to make it more interesting.
3. When students report the results of their group work, students are given awards so that other groups want to convey the results of their group work.

Cycle II

a. Action plan

1. Cycle II corrective actions will be carried out on:
   Meeting 3: Monday, October 15th, 2018
   Meeting 4: Wednesday, October 17th, 2018
2. Learning equipment that will be prepared by RPP, student worksheets, various kinds of clock models.
3. Changing pairs of students for their classmates, namely by choosing friends who are more familiar so that it is easier for them to communicate in learning.

b. Action implementation.

1. Initial Activity (10 minutes)
    1. The teacher gives an initial test of the lesson by asking questions about the previous lesson.
    2. The teacher motivates the students by singing the song Names of the Day.
    3. The teacher conveys the learning objectives.
2. Core Activities (45 minutes)
    1. The teacher asks a question or problem related to the lesson.
    2. The teacher explains how to solve time problems in everyday life.
    3. The teacher arranges student seats according to the action plan.
    4. The teacher distributes student worksheets.
    5. Students in small groups discuss working on practice questions about how to solve time problems in everyday life.
    6. Students take turns representing the discussion group reporting the results of their group work with the guidance of the teacher.
    7. Students in pairs with their classmates practice turning the long and short hands of the clock according to the specified time, on the hour provided by the teacher.
3. Final Activity (15 minutes)
    1. Students conclude the subject matter at the end of the lesson guided by the teacher.
    2. Students do the evaluation.
    3. The teacher writes homework on the blackboard.

c. Observation/ Observation

4. The things observed by observers in cycle II are as follows:
   Teacher Activities:
    1. In motivating students the teacher does not give examples that are usually experienced by students.
    2. The teacher is quite relevant in giving apperception.
    3. Management of smart student seating arrangements for friends who are less able to learn is very helpful in the learning process.
    4. Teacher supervision of students during the learning process is better.
    5. Teachers are better at facilitating students in learning.

   Student Activities:
    1. Some students are still not well motivated.
    2. Students are very responsive to the apperception of the teacher and can answer questions from the teacher about the past lesson.
    3. Smart students really help students who are less able to learn.
    4. Students learn more conducive because they feel cared for thoroughly.
    5. In general, students have the courage to come to the front of the class to write down their work, dare to ask questions, and answer questions from the teacher even though there are still some students who are still passive in learning.
    6. Between smart students and their classmates, there has been good communication and cooperation in learning.
    7. In general, students can conclude the subject matter.

d. Reflection

After analyzing the weaknesses and strengths of teaching teachers in the second cycle planning, for further planning, the following actions will be added:

1. Teachers must always relate the subject matter to the experiences of students in everyday life.
2. Teachers must make students the center of learning while the strength that must be continuously improved is the management of varied seating arrangements.
3. The learning system should be more attractive to students.

Data analysis technique

Data analysis was used to classify mathematics learning outcomes with the Think Pair Share Cooperative learning model in grade 3 Marsudirini Perawang elementary school. The author uses the following formula:

$$\mathbf{M= \frac{X}{N} \ x\ 100}$$

M = Student scores
X = Correct number of questions
N = Number of questions

(Purwanto, 2013)

Table 1. Grouping of Student's Values Based on the Interval of Values

Value Interval	Category
81 – 100	Very Good
61 – 80	Good
41 – 60	Sufficient
21 – 40	Less
0 – 20	Very Less

Source :Purwanto, 2013

The results of the percentage of learning outcomes using the above formula will be compared with the percentage of completeness in the previous cycle. If there is an increase, it can be assumed that the application of the Think Pair Share Cooperative learning model in grade 3 Marsudirini Perawang elementary school is declared successful.

C. FINDINGS AND DISCUSSION

Description of Initial Value Discussion

Based on the previous explanation, classroom action research aims to find ways to improve mathematics learning outcomes by applying the Think Pair Share Cooperative learning model. This research was conducted in grade 3 Marsudirini Perawang elementary school which consisted of 30 students. Before carrying out the improvement of learning, the author first gave an initial test to students. This test aims to determine the basic abilities of students in mathematics before using the Think Pair Share Cooperative learning model in the learning process. Then the authors carry out the learning process using the Think Pair Share Cooperative learning model.

At the end of the I meeting of the first and second RPP, the second meeting of the third and fourth RPP, the writer gave daily test I and daily test II. Giving daily test I and daily test II aims to determine the ability of student learning outcomes after the application of the Think Pair Share Cooperative learning model in the learning process.

Pretest Results

The initial test was carried out before the writer carried out the improvement of learning in students. This test was carried out in grade 3 Marsudirini Perawang elementary school, October 2rd, 2018.

Table 2. Grouping of Pretest Scores

No.	Value Interval	Category	Frequency	Percentage
1	81-100	Very Good	0	0
2	61-80	Good	6	20%
3	41-60	Sufficient	8	27%
4	21-40	Less	12	40%
5	0-20	Very Less	4	13%
	Total		30	100%

Based on the table above, it can be seen that the initial scores of 6 students (20%) were in the good group, 8 students (27%) in the sufficient group. In the less group, 12 students (40%) and 4 students (13%) were in the very poor group.

Description of Learning Improvement Research Results

The action referred to in this research is the application of the Think Pair Share Cooperative learning model to the time unit material in grade 3 Marsudirini Perawang elementary school. The implementation of the action in this study consisted of four meetings with the lesson plans and two daily tests. The implementation of the daily test I was after the first and second meetings, while the implementation of the second daily test was after the third and fourth meetings.

Cycle I

Cycle I was conducted in two meetings and one daily test.

First meeting (Monday, October 8th, 2018)

At the first meeting, the learning activities discussed solving the problem of time. It begins with praying, greeting, and asking the students' condition. Furthermore, the teacher conveys the material to be studied, the teacher conveys the learning objectives and explains the technical implementation of the learning to be achieved after learning. The teacher motivates students to be more enthusiastic about participating in learning, and reminds students by asking questions about what time they wake up and what time they go to school. Next, the teacher explains the outline of the material that will be studied by students in the discussion. The teacher asks students to sit in pairs. The teacher distributes student worksheets and asks students to work on the worksheets that have been distributed by discussing with their partners. Almost every couple has difficulty in doing worksheets. The teacher guides students who have difficulty. After finishing the discussion, the teacher asked one of the pairs to convey the results of the discussion, while the other groups observed and gave their responses. The teacher guides the discussion to formulate the correct answer and gives awards in the form of compliments to partners based on the results of their group work. At the end of the lesson the teacher guides students to conclude the material that has been studied, then students are given formative tests to solve problems about time.

In the discussion process, there were still couples playing around, some being confused, and there was a lack of discussion between partners. There are still couples who work on worksheet expecting orders from the teacher and do not understand how to do it, because students are not used to using worksheet. Only some pairs who want to learn and discuss, namely students or couples who understand. Meanwhile, students or couples who do not understand are just silent, and wait for answers from their friends, do not dare to ask and answer questions from the teacher. The learning process has not gone as expected.

To overcome this condition the teacher takes action, namely trying to explain the steps for working on the worksheet so that students are directed and understand how to solve problems about time. Then emphasize the students that in discussing, friends who can have to help friends who can't. Next, the teacher gives homework for practice at home.

Based on the results of the researcher's discussion with the observers at the first meeting, that the cooperation in pairs has not gone as expected, because during noisy class discussions, there are still many students who do not dare to ask questions, many do not understand the discussion activities. The teacher gives too much guidance to students and students with low abilities are still shy to ask their partner (friend).

Second meeting (Thursday, 11st October 2018)

At the second meeting, the learning activities were discussing how to change the units of time from minutes to seconds, hours to minutes, hours to seconds. Before the learning activities begin, the teacher and students discuss together homework that is considered difficult, then remind students about the technical learning that will be carried out. The teacher conveys the learning objectives and motivates students to carry out learning activities and demonstrates how to read the clock according to the long and short hands seen on the clock, then the teacher

explains the outline of the material to be studied. The teacher asks students to sit according to their respective pairs that have been formed in the previous meeting. The teacher distributes the second worksheet, students work on the worksheet in discussion with their partners, the teacher guides couples who have difficulty working on the worksheet.

The teacher asks one group to report the results of their discussion and another group observes and provides feedback. The teacher guides the presentation by directing students to formulate the correct answers and giving praise to all groups, especially groups that have presented the results of their discussions. The teacher motivates students so that the next presentation will be even better. The teacher and students conclude the material that has been studied. At the end of the lesson the teacher gives the task of making a picture of a clock out of cardboard according to the time determined by the teacher.

Based on the results of the researcher's discussion with the observers at the second meeting, the activities of teachers and students have increased. In group discussions, it was already seen that there was cooperation with their partners, although there were still some students who did not care about their groups and only saw their friends working. At the time of presentation, there were still students who did not want to give feedback, especially students who were shy and did not understand the material being taught.

Implementation of Daily Test I Cycle I (Friday, 12rd October 2018)

The teacher gives the first daily test with the main material knowing the unit of time. The test is carried out for 70 minutes with a total of 10 questions in the form of a description. In the implementation of the Daily Test I, there were students who tried to see the results of their friends. To overcome this, the teacher provides motivation so that students believe in the results of their own work. Five minutes before the end of time, all answer sheets were collected.

Table 3. Grouping of Daily Test Values I

No.	Value Interval	Category	Frequency	Percentage
1	81-100	Very Good	3	10%
2	61-80	Good	8	27%
3	41-60	Sufficient	10	33%
4	21-40	Less	7	23.3%
5	0-20	Very Less	2	6.7%
	Total		30	100%

Based on the table above, it can be seen that the initial scores of 8 students (27%) were in the good group, 10 students (33%) in the sufficient group. In the less group, 7 students (23,3%) and 2 students (6,7%) were in the very less group.

Results of Observation of Student and Teacher Activities

The author carried out observations of students during the learning process took place. The activities observed included discussing student worksheets, reporting the results of the discussions and answering questions.

Table 4. Percentage of Student Activity Cycle I

No	Student Activity	Student Activity (%) Cycle / Meeting	
		I/I	I/II
1	Answer the question	16.00%	40.00%
2	Discussing Student Worksheets	10.00%	33.00%
3	Reporting Discussion Results	26.00%	33.00%
	Total	**52**	**106**
	Rate (%)	**17.3%**	**35.3%**

The results of the observation of student activities in the first meeting explained that 5 students (16%) answered the teacher's questions, 3 students (10%) discussed student worksheets and 8 students (26%) reported the results of the discussion. Below you can see the percentage of

student activities in cycle I meeting 2.Based on the results of observations of student activities in the first cycle of the second meeting, 12 students (40%) answered the teacher's questions, 10 students (33%) discussed student worksheets and 10 students (33%) reported the results of the discussion. The following can be seen the percentage of observations of teacher activities.

First Cycle Reflection

After carrying out the first cycle of learning process with 2 meetings, the writer gave daily test I. The results of the first daily test were 19 students out of 30 students who scored below the minimum completeness criteria (KKM). 10 students or 33% get sufficient category, 7 students or 23,3% get less category, and 2 students or 6,7% get very less category. The minimum completeness criteria are said to be successful if students scored 70 or above the minimum completeness criteria. In other words, cycle I was not successful. Only 37% students get above the minimum completeness criteria. This is due to 2 factors, namely student and teacher factors. From the student factor, there are still many students who are not actively asking questions, are not involved in discussions and do not have the enthusiasm to learn. From the teacher factor, the teacher does not give students the opportunity to ask questions, does not make lesson conclusions and does not motivate students. From the explanation above, it can be concluded that the first cycle was not successful so it was necessary to carry out the second cycle.

Cycle II

Cycle II was conducted in two meetings and one daily test. The teacher uses time as efficiently as possible, provides even guidance, and is as firm as possible in the classroom.

Third meeting (Monday, 15th October 2018)

The third meeting began by discussing the task of making a clock out of cardboard. Learning activities, namely students can determine the time that is guided by the Learning Implementation Plan (third lesson plan) and worksheet. The learning process begins by conveying the learning objectives, namely students can determine the time. The teacher motivates students to carry out learning activities by inviting students to sing back the song "Puzzles". The teacher asks questions to recall how to change the unit of time that has been learned.

The teacher presents the lesson material on how to determine the time and asks students to sit with the same partner at meetings 1 and 2. The teacher distributes worksheet -3, students work on the worksheet according to the instructions. In work there are still couples who are confused about what to do. The teacher provides guidance to couples who are still confused and always motivates students to be active in group activities. The teacher asks one group to report the results of their group's work, the other group gives a response. The teacher guides the presentation by directing students to formulate the correct answer, then gives awards in the form of praise to the group based on the results of their group work. Finally, the teacher and students conclude the subject matter. At the end of the lesson, students were given tests and homework.

Based on the results of discussions between researchers and observers, the implementation of learning in general was better than the second meeting. Implementation is in accordance with the plan. Student activity in the discussion is quite good, there are only a few students who have not mastered the lesson.

Fourth Meeting (Wednesday, 17th October 2018)

The fourth meeting begins with discussing homework, learning activities about solving time problems in daily life based on Lesson Plan-4 and worksheet-4. The learning process begins with conveying the learning objectives. The teacher motivates the students by singing the names of the days. The teacher asks questions to recall how to determine the time that has been studied previously that supports the material to be studied.

The teacher presents the material, then asks students to sit in the same pairs as the previous meeting. The teacher distributes worksheets, students work on worksheets with their partners. The teacher guides students and always motivates students to be active in group activities. The teacher asks one of the pairs to present the results of their discussion, the other

groups give their responses. The teacher guides the presentation by directing students to formulate the correct answer. After the presentation activity ended, the teacher gave an award in the form of praise to the couple who had presented their work. The teacher and students conclude the subject matter. At the end of the lesson students do the evaluation and remind students at the next meeting there will be a daily test. Based on observations, it is known that the activities of teachers and students have been carried out according to plan.

Implementation of Daily Test II (Friday, 19th October 2018)

At this meeting, a daily test was carried out which was attended by 30 students by giving a test of learning outcomes on the unit of time material. In the implementation of the second daily test, all students worked on the questions in an orderly manner, no more trying to cheat and opening their math exercise book. Five minutes before the end of time, all answer sheets were collected, then students whose scores were still below the KKM were agreed to be held remedial.

Table 5. Grouping of Daily Test Values II

No.	Value Interval	Category	Frequency	Percentage
1	81-100	Very Good	8	26%
2	61-80	Good	14	47%
3	41-60	Sufficient	5	17%
4	21-40	Less	3	10%
5	0-20	Very Less	-	-
	Total		30	100%

Results of Observation of Student and Teacher Activities

The author carried out observations of students during the learning process took place. The activities observed included discussing student worksheets, reporting the results of the discussions and answering questions.

Table 6. Percentage of Student Activity Cycle II

No	Student Activity	Student Activity (%) Cycle / Meeting	
		II/III	II/IV
1	Answer the question	57.00%	70.00%
2	Discussing Student Worksheets	50.00%	67.00%
3	Reporting Discussion Results	53.00%	83.00%
	Total	**160**	**220**
	Rate (%)	**53.3%**	**73.3%**

The results of observing student activities at the third meeting above explained that 17 students (57%) answered the teacher's questions, 15 students (50%) discussed student worksheets and 16 students (53%) reported the results of the discussion. Below you can see the percentage of student activities in the second cycle of the fourth meeting.Based on the results of observations of student activities in the second cycle of the fourth meeting, 21 students (70%) answered the teacher's questions, 20 students (67%) discussed student worksheets and 25 students (83%) reported the results of the discussion. The following can be seen the percentage of observations of teacher activities.

Second Cycle Reflection

After carrying out the learning process in the third and fourth meeting cycle II, the author gave a daily test II to see the improvement of student learning outcomes. The results of the second daily test were 8 students out of 30 students who scored below the minimum completeness criteria (KKM). 5 students or 17% get sufficient category and 3 students or 10% get less category. But there's no students get very less category in the second daily test. In the results of the Daily Test II the average score of students increased above the minimum completeness criteria. It's 73%

students get above the minimum completeness criteria. Based on the results above, it can be seen that more than 70% of students actively ask questions, conduct discussions and report the results of the discussions. In the learning process the teacher also motivates students, provides opportunities to ask questions and make conclusions so that students understand the lesson better. The implementation of the improvement of the second cycle of learning with the Cooperative Think Pair Share model is categorized as successful.

Discussion of Research Results for Improvement of Learning

Based on the observations in cycle I and cycle II, the authors found an increase in student learning outcomes starting from the initial test, daily test I and daily test II can be seen from the following table.

Table 7. Percentage of Student Activities

Student Activity	Cycle I				Cycle II			
	1		2		3		4	
	F	%	f	%	F	%	F	%
Answer the question	5	16.00	12	40.00	17	57.00	21	70.00
Discussing Student Worksheets	3	10.00	10	33.00	15	50.00	20	67.00
Reporting Discussion Results	8	26.00	10	33.00	16	53.00	25	83.00
T. Average	**5**	**17.33**	**11**	**35.33**	**16**	**53.33**	**22**	**73.33**
	8 (18.12%)				**19 (63.33 %)**			

Based on the diagram above, it can be seen that the average student in the first cycle of the first meeting was 5 students (17.33%), 11 students (35.33%) in the second meeting. In the second cycle, 16 students (53.33%) in the third meeting, 22 students (73.33%) in the fourth meeting. Below is the percentage of the initial value, daily test I and daily test II.

Table 8. Percentage of initial value, daily test I and daily test II

No	Value Interval	Category	Frequency			Percentage		
			Initial Value	Daily Test I	Daily Test II	Initial Value	Daily Test I	Daily Test II
1	81-100	Very Good	-	3	8	0	10.0%	26.0%
2	61-80	Good	6	8	14	20.0%	27.0%	47.0%
3	41-60	Sufficient	8	10	5	27.0%	33.0%	17.0%
4	21-40	Less	12	7	3	40.0%	23.3%	10.0%
5	0-20	Very Less	4	2	-	13.0%	6.7%	0
Total			**30**	**30**	**30**	**100%**	**100%**	**100%**

In the diagram above, it can be seen that the increase in mathematics learning outcomes for the 3rd grade students of Marsudirini Perawang elementary school. The very good category score of the students on the initial test was 0%, on the first daily test it increased to 10% and on the second daily test it increased to 26%. The average score of students on the second daily test increased above the minimum completeness criteria (KKM) that had been determined by the school (73>70).

Based on the explanation above, it was found that the average value of daily test results I and II was higher than the average value on the initial test. From the analysis of the cycle data above, the writer can conclude that the mathematics learning outcomes of the 3rd grade

students of Marsudirini Perawang elementary school using the Think Pair Share Cooperative model have increased.

D. CONCLUSION

Based on the results of Classroom Action Research to seek to improve student learning outcomes for grade 3 mathematics subjects at Marsudirini Perawang elementary school, it can be concluded that applying Think Pair Share cooperative learning can improve mathematics learning outcomes for grade 3 students at Marsudirini Perawang elementary school from the average learning outcomes obtained. Then by applying Think Pair Share Cooperative learning, students can respond to be active in learning activities. Think pair share (TPS) cooperative learning model is a learning model that invites children to think, socialize, be brave, and cooperate with friends. So before the learning process using the Think Pair Share (TPS) type begins, the teacher should arrange the seats of the smart students with those who are less so that the learning process can run as expected.

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Reasoning Habits of Students through Realistic Mathematics Problems

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Abstract

A realistic math problem is one of the math problems whose solution requires a reasoning habit. Reasoning ability will increase if students often practice their reasoning habits. By solving realistic math problems, it is expected that students' reasoning habits can be trained well. This study aims to describe the reasoning habits of class VIII students of MTs Sunan Kalijogo Kranding Kediri Regency, East Java, Indonesia in solving realistic math problems in terms of 4 stages of reasoning habits. This study uses a qualitative approach with a descriptive type of research. The data collection technique in this study used a mathematical reasoning ability test sheet and interviews. The subjects in this study were students of class VIII F MTs Sunan Kalijogo Kranding, totaling 28 students, then three students with high, medium, and low categories of reasoning habits were taken to conduct interviews. The results of this study indicate that students with high-category reasoning habits can fulfill the four stages of reasoning habits. Students with reasoning habits in the medium category can fulfill two stages of reasoning habits. Students with low-category reasoning habits are not able to fulfill the four stages of reasoning habits. The results of this study are useful for choosing the right learning method in improving students' reasoning abilities, such as using realistic mathematics learning or Project Based Learning (PBL).

Keywords: *Reasoning Habits; Realistic Mathematics Education*

A. Introduction

The development of the times makes science and technology also change (Yoga, 2018). The availability of very abundant information requires us to have the ability how to process it (Setiani et al., 2015). Critical, systematic, logical, and creative thinking is needed in processing the information ((Fuadi et al., 2016)). These skills can be obtained by learning mathematics (Maryanih et al., 2018). Therefore mathematics is needed to solve various problems including in dealing with technological developments.

Mathematics is taught from elementary school to the university level (Wibowo, 2017). One of the mathematical objectives that have been written in Permendiknas No. 22 of 2006 is to use reasoning on patterns and properties, perform mathematical manipulations in making generalizations, compiling proofs, or explain mathematical ideas and statements so that they are able to solve mathematical problems. Based on the description above, one of the subjects that can improve students' reasoning so that students can communicate well with their environment is mathematics.

Mathematical reasoning is one of the basic mathematical abilities to understand concepts and formulate ideas mathematically (Ball & Bass, 2003). Mathematical reasoning is considered the "adhesive" that can help students understand mathematics (Askew, 2020). (Ario (2015) states that, in addition to the cognitive aspect in the form of reasoning ability, the affective aspect in the form of reasoning habits is also the goal of learning mathematics. It can be said that mathematical reasoning abilities can be developed through reasoning habits in understanding mathematical concepts.

Reasoning habits are productive ways of thinking that are common in the process of mathematical investigation and idea generation (NCTM, 2016). Hima & Anwar (2016) explained that students must make observations, submit conjectures, and experience wrong prefixes and incomplete explanations, before reaching a logical conclusion when involved in the mathematical reasoning process. Therefore, mathematical reasoning habits can be developed after students are involved in the learning process. NCTM (2016) explains that reasoning habits are divided into 4 stages, (1) analyzing problems, (2) applying strategies, (3) finding and connecting between mathematical contexts, and (4) reflecting on solutions. In this study, the reasoning habits of students in working on mathematical problems will be explained using the 4 stages of reasoning habits initiated by the National Council of Teachers of Mathematics.

Based on the 2011 TIMSS study, Indonesian students' math and science abilities are ranked 38 out of 42 countries (Hadi & Novaliyosi, 2019). Cognitive ability at the level of reasoning of class VIII students has the lowest average percentage of 17% (Rosnawati, 2013). Previous research has shown that the mathematical reasoning of students is weak because of the lack of training of students in solving problems that require reasoning (Raharjo et al., 2020). This is following the sresearch of Rizta et al. (2013) that teachers in class more often give questions that emphasize understanding concepts, but also that require higher-order thinking such as reasoning are still rarely given. There are still many students who have not applied the reasoning habit in solving the mathematical problems they face (Fajariyadi, 2016).In connection with these problems, a learning approach that can be an alternative to improve students' mathematical reasoning is a realistic mathematical education (RME) approach.

In RME, context problems are defined as experientially real problem situations for students thus the problem played from the start onwards (Gravemeijer & Doorman, 1999). This realistic mathematical approach uses problems that easily be imagined or real in students' minds, so students will determine and reconstruct the problems themselves given (Fauzan et al., 2016). Therefore, students' mathematical experience and reasoning will increase. Realistic mathematical problems in this study are applied to geometry material.Kusniati (2011) stated one of the mathematical materials that are often a problem for students is geometry. According to Sholihah & Afriansyah (2018), geometry is a branch of mathematics that has a greater chance than other branches of mathematics to be understood by students, because geometric ideas have been known to students since before they entered school, for example, lines, planes, and spaces.

One of the mathematics teachers at MTs Sunan Kalijogo Kediri Regency, East Java stated that there were still many students who did not understand the story problems that required

reasoning on the material of cube and cuboid geometry, so they still had difficulty solving the story problems. According to research by Maryanih et al. (2018) students have difficulty solving cube and cuboid problems because they do not understand the concepts of cube and cuboid. In solving questions of reasoning ability, there are various mistakes made by students, it is included there are various mistakes made by students (Ario, 2016). The student learning difficulties in solving generalization problems are not understanding questions, difficult to determine the strategy to be used, the occurrence of misconceptions in other words lack of prerequisites material (Lestari, 2015). It can be said, students can receive material and solve questions but cannot make it meaningful, namely being able to solve other problems outside the context of the problem. For example, if students are given questions of a different form or given a more difficult level of questions, students can also solve them, but in reality students often still find it difficult and eventually give up if they can't do it.

Mathematical reasoning has been studied by several researchers including, Oktaviana & Aini (2021) and Saragih (2020) regarding the analysis of the mathematical reasoning abilities of junior high school students on social arithmetic material and problem-based problems in junior high school students respectively. Next, Raharjo et al. (2020) and Agustin (2016) examine mathematical reasoning abilities with an open-ended and problem-solving approach. Followed by Fauzan et al. (2016) and Mbagho & Tupen (2020) are about an effort to improve reasoning or learning outcomes with a realistic mathematical approach. However, research on students' reasoning habits through realistic math problems has not been widely studied. By giving realistic problems on cube and cuboid material to students, it is expected to obtain a description of students' reasoning habits in solving them. The role of reasoning in solving problems is so important, and the results of this study can be used to determine the level of students' reasoning habits so that teachers can determine how good learning is used in the classroom so that students' reasoning habits increase. Therefore, this study aims to describe the reasoning habits of students through realistic math problems at MTs Sunan Kalijogo Kranding Kediri Regency, East Java.

B. Methodology

1. Research Design

The approach used in this research is a qualitative approach with a descriptive research type. This type of research is descriptive qualitative research, therefore the presence of the researcher is very important because the researcher is the main instrument. Researchers are present at the research location to collect data needed in research. The data generated in this qualitative approach is descriptive in the form of speech or writing and the behavior of the people being observed, so that the data analyzed is in the form of detailed and careful descriptions of certain symptoms or phenomena in more depth (Rukajat, 2018). Information collection in descriptive research regarding research subjects applies at a certain time (Saragih, 2020). The purpose of this study was to describe the reasoning habits of students in solving realistic mathematical problems on cubes and cuboid based on high, medium, and low level reasoning categories in MTs Sunan Kalijogo Kranding students.

2. Instruments

The instruments used in this study were the students' mathematical reasoning ability test sheets (LTKPMS) and interview guidelines.

This research uses a test to measure the level of students' reasoning habits on cubes and cuboid using realistic math problems. The questions are given in the form of descriptions, this is done so that it is easier for researchers to measure students' reasoning habits according to the correct answer keys at each stage of reasoning habits.

Students' mathematical reasoning ability test sheets are made to measure students' reasoning habits. LTKPMS are arranged in two types, in the form of descriptions. The questions given in the first test aim to categorize subjects based on high, medium and low levels of reasoning. Whereas the second test item was only given to selected subjects with high, medium, and low levels of reasoning and each level had 1 research subject. This second test is intended as a comparison, whether the results of the first and second tests will produce scores in the same

category for the selected subject or not. LTKPMS contains different questions but has the same equivalence. Each question contains 2 questions.

The LTKPMS instrument was developed which refers to the 5 characteristics of Realistic Mathematics Education by (Treffers, 1987) and the 4 stages of reasoning habits adopted from NCTM (2009). Indicator of questions and interviews used to measure students' reasoning habits: (1) Analyze problems; (2) implementing strategy; (3) Finding and connecting between mathematical contexts; and (4) Reflecting on solutions (NCTM, 2016).

The steps taken by the researchers to collect data were to prepare a grid of test questions, create test questions and scoring guidelines, ask for validation from 3 Lecturers of the Mathematics Education Program, and 1 math teacher, then conduct the test. The test questions contain the stages of reasoning habits that will be carried out by students and the results of student answers will be collected and analyzed by researchers.

The reasoning habits test questions can be seen below.

A bathtub is 2 m long, 1 m wide, and 1 m high. The bathtub leaked at the top, so it could only be filled 3/4 of the way. Determine how many liters of water are needed to fill the tub. (liter=dm^3)

Look at the following illustration (Figure 1).

A house that looks like a cuboid will be painted on the outside with a length of 12 m, a height of 4 m, and a width of 6 m. To make it easier to estimate the paint needed, the handyman ignored the existing windows and doors, in calculating the area. If every 12 m^2 requires 1/3 can of paint, how many cans are needed to paint the walls of the house?

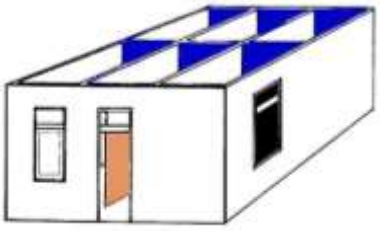

Figure 1. Illustration Problem 2

3. Technique of Data Analysis

The reasoning habits test was given to 28 class VIII F students of MTs Sunan Kalijogo. The results of the reasoning habits test were categorized into three categories which were then used to select research subjects. The data collection technique used purposive sampling, namely students who had good communication skills so that one subject was selected each from the categories of high, medium, and low reasoning habits.

Table 1 is used to determine the categories of students' reasoning habits based on test scores. The scoring technique used in this study is to give a score at each stage of reasoning habits which are presented in Table 2.

Table 1. Reasoning Habits Category

Category	Percentage of Score (x)
High	$x > 70$
Medium	$55 < x \leq 70$
Low	$x \leq 55$

(Suprihatin et al., 2018)

Table 2. Reasoning Habits Test Scoring Techniques

Reasoning Habits Stages (NCTM, 2009)	Score	Indicators
Analyzing the problem	1	Unable to analyze problem
	2	Analyze the problem incorrectly
	3	Analyze the problem correctly, but not according to the mathematical concept
	4	Analyze the problem properly
Implementing the strategy	1	Unable to implement strategy

	2	Implement the strategy wrong
	3	Implement the strategy correctly, but there are answers that are not quite right
	4	Implementing the right strategy
Finding and connecting between mathematical contexts	1	Unable to search and connect between mathematical contexts
	2	Find and connect between mathematical contexts incorrectly
	3	Find and connect between mathematical contexts correctly, but there are answers that are not quite right
	4	Find and connect between mathematical contexts appropriately
Reflecting the solution	1	Unable to reflect the solution
	2	Reflect the solution incorrectly
	3	Reflect the solution correctly, but give the wrong reasons
	4	Reflect the solution correctly

$$\textbf{Percentage Score} = \frac{\textbf{Student score}}{\textbf{Maximum score}} \times \textbf{100}\ \%$$

(Nurhayati et al., 2013)

Checking the validity of the data was carried out using triangulation techniques by comparing the results of tests and student interviews, and using member checks which were carried out on interview subjects.

C. Findings and Discussion

1. Findings

The results of this study are presented following the research objectives, namely to describe students' reasoning habits based on 4 stages of reasoning habits adopted from NCTM (2016), namely: (1) Analyzing problems, (2) implementing strategies, (3) finding and connecting between mathematical contexts, and (4) reflecting on the solution.

Based on the test results of 28 students, then an assessment was carried out by the researcher. Based on the results of the assessment, the reasoning habits category was obtained according to Table 1, namely 6 students in the high category, 11 students in the medium category, and 11 students in the low category. From each category, one subject is taken to represent each category of reasoning habits. The following are the research subjects based on test results and recommendations from mathematics teachers.

Table 3. Research Subjects Interviewed

Name	Code	Score	Percentage	Category
TR	S1	31	96,87%	High
LP	S2	22	68,75%	Medium
AM	S3	14	43,75%	Low

The following are the results of the analysis of students' reasoning habits based on 4 stages of reasoning habits which were adapted from NCTM (2016).

Reasoning habits of high category student

Figure 2 shows the answers to the reasoning habits test at number 1 by subjects with high categories.

The first stage of reasoning habits is analyzing the problem. It can be seen in Figure 2 that S1 can identify problems well, by writing coherently and in detail the information that is known and asked, and can write and explain well the plan to solve the problem that will be used. The first step taken by S1 is to write down the information that is known and asked in the question. S1 writes down the methods and formulas that will be used to solve the problem. The formula they

use is the formula for the volume of a cuboid. The volume of the cuboid is multiplied by 3/4 , because the tub can only be filled with 3/4 of it. The unit is changed to liters according to the request in the problem. So it was concluded that S1 was able to fulfill the stages of analyzing the problem well.

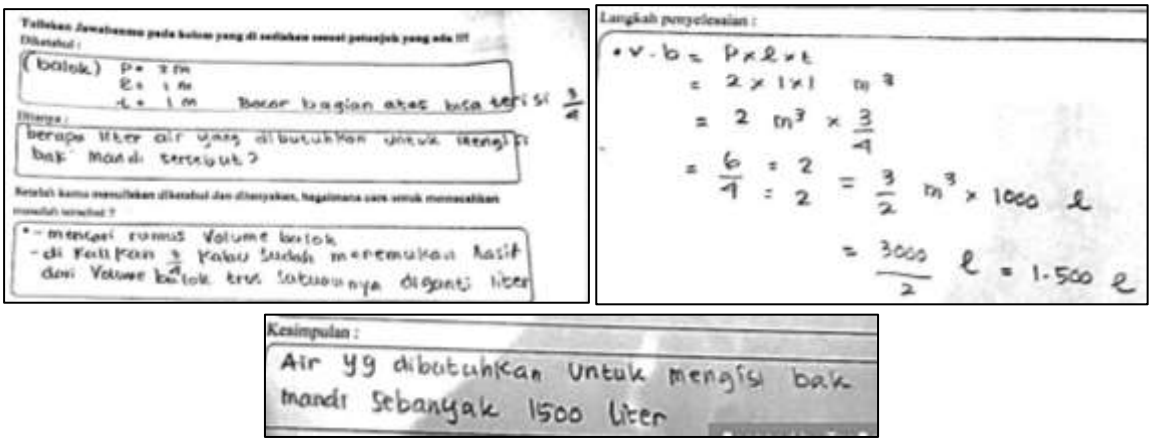

Figure 2. S1 reasoning habits test solutions

At the stage of implementing the strategy, S1 can implement the strategy because S1 can implement the plans that have been made with systematic steps and according to what has been planned, S1 is also able to provide reasons why he chose the plan. S1 can fulfill the stages of implementing the strategy well.

In the stage of finding and connecting between mathematical contexts, S1 is also able to fulfill this stage by connecting between the known and asked information, and being able to mention other mathematical concepts related to the given problem. This is shown from the results of the answer S1 (Figure 2) in connecting the known and asked information well so that it can solve the problem correctly. Based on the results of the interview, the subject of S1 is also able to determine other mathematical concepts related to the given problem, namely changing the unit m^3 to liters, by multiplying with 1000 because the unit liter is the same as dm^3. S1 subjects are also able to make decisions based on the answers they get to draw final conclusions. S1 subjects are able to fulfill the stages of finding and connecting between mathematical contexts well.

S1 can reflect the solution well. This is shown from the results of S1's answer in determining the conclusion correctly, namely the water needed to fill a bathtub with a length of 2m, a width of 1m, a height of 1m, and can only be filled 3/4 of the way due to a leak of 1500 liters. Based on the results of the interviews before concluding, they re-checked the correctness of the answers at each calculation step that was written.

Reasoning habits of medium category student

Figure 3 shows the answers to the reasoning habits test at number 2 by subjects with medium categories.

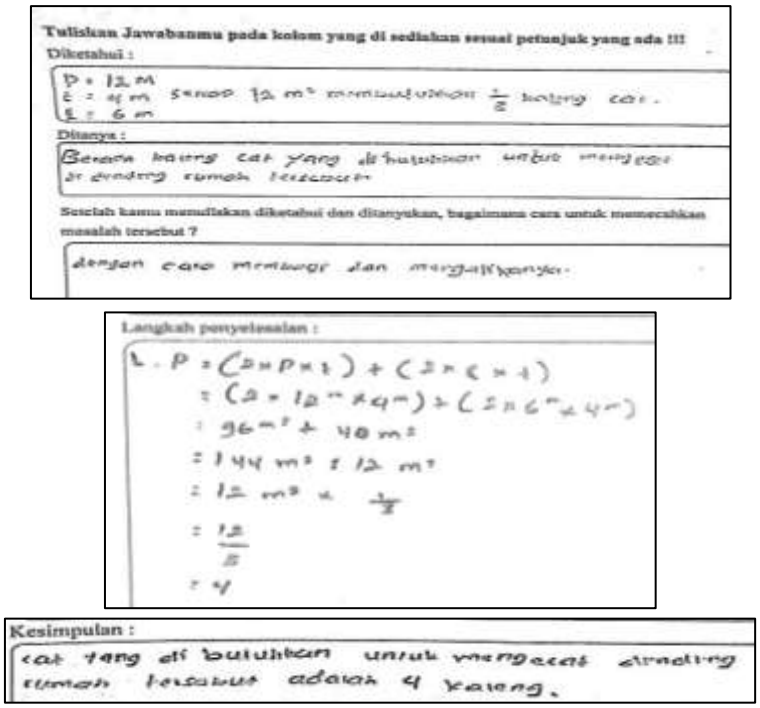

Figure 3. S2 reasoning habits test solutions

S2 can fulfill the stages of analyzing problems. S2 writes coherently and in detail the information that is known and asked, and can write and explain well the plans to solve the problems that will be used, although in writing the completion plans are not written step by step, but made into one sentence.

In the stage of implementing the strategy, S2 can implement the plan that has been made with systematic steps and according to what has been planned, S2 is also able to provide reasons why he chose the plan.

The third stage is finding and connecting between mathematical contexts. S2 still does not complete this stage because S2 has not been able to mention other mathematical concepts related to solving the problem. In the S2 interview process, you cannot explain other mathematical concepts related to completing the given test.

The last stage is reflecting the solution. S2 has not been able to reflect on the solution because S2 is only able to write conclusions on the test sheet, but S2 has not checked the correctness of the answers. Based on the results of the interview, S2 has not checked the correctness of the answers obtained before drawing conclusions. This is because S2 already feels confident and reluctant to re-examine the answers he has obtained.

Reasoning habits of low category student

Figure 4 shows the answers to the reasoning habits test at number 2 by subjects with low categories.

The first stage of reasoning habits is to analyzing the problem. It can be seen in Figure 4 that S3 has not been able to identify the problem, because S3 has not been complete in writing down the information that is known and asked, and has not been able to write and explain well the plan to solve the problem that will be used. S3 subjects use the formula for the volume of the cuboid directly, namely by multiplying the length, width, and height of the bath.

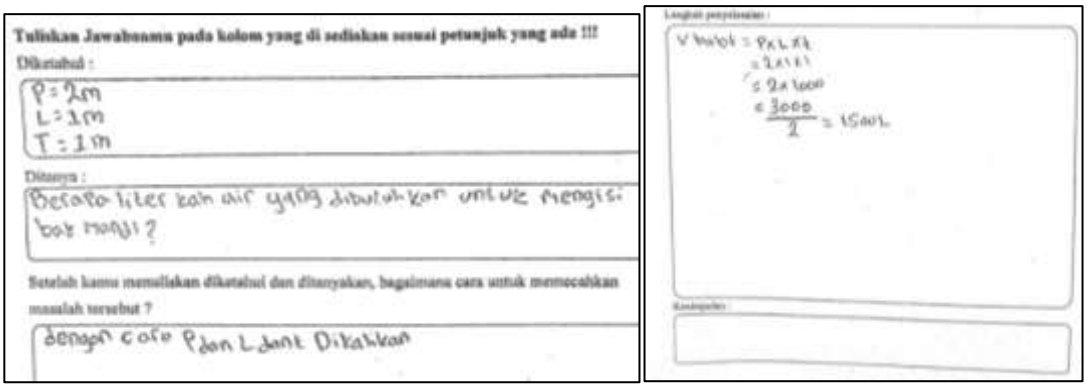

Figure 4. S3 reasoning habits test solutions

S3 has not been able to fulfill the stages of implementing the strategy, because S3 is still wrong in the calculation and planning process carried out. S3 also does not fully understand what plans will be made to solve the problems given. Based on the results of the interviews, it was shown that S3 was still confused about the completion steps they were working on, resulting in incorrect answers. This is probably because he was incomplete in writing down information at the stage of analyzing the problem, thus causing the next stage to produce inaccurate answers.

At the stage of finding and connecting between mathematical contexts, S3 has not been able to fulfill it well. S3 does not know at all other mathematical concepts related to the given problem. Based on the results of the interview, the doctoral subject has not been able to determine other mathematical concepts related to the questions given. S3 also have not been able to make decisions to conclude. This is possible because he did not understand well the problems presented, and did not understand the mathematical concepts in the material of building cubes and cuboids, resulting in the wrong answer.

The last stage, S3 has not been able to reflect on the solution. The S3 subject could not answer at all what the final conclusion was. This is because S3 still finds it difficult to identify the given problem, so S3 cannot solve the given problem.

The results of the research can be presented with findings related to students' reasoning habits through realistic math problems as shown in Figure 5.

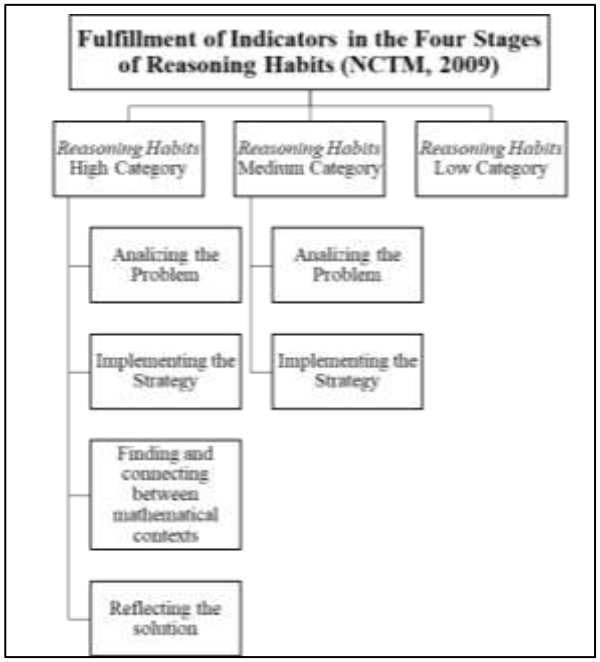

Figure 5. Findings

2. Discussion

Based on the result in the previous description, S1 can fulfill the 4 stages of reasoning habits well. Students with high-category reasoning habits can fulfill the four stages of reasoning habits correctly and completely, namely analyzing problems, implementing strategies, finding and connecting between mathematical contexts, and reflecting on solutions. This is following Safitri (2018) that students who have good thinking habits, then these students can understand the problems found in each lesson well. Raharjo et al. (2020) found that students with high reasoning can identify problems by providing information about known and asked information from the questions, and can make assumptions correctly to solve problems so that students with high reasoning categories can master the four indicators of mathematical reasoning. In line with Hidayati & Widodo (2019), students who have high mathematical reasoning can construct valid arguments using systematic steps.

Students with reasoning habits in the medium category were able to fulfill two stages of reasoning habits, namely at the stage of analyzing problems and implementing strategies, while the other 2 stages of reasoning habits still did not meet. This is following the results of research from Saragih (2020) that students with moderate reasoning can fulfill 2 reasoning indicators from the 4 reasoning indicators analyzed. But not in line with Oktaviana & Aini (2021) who state that students with moderate mathematical reasoning can write and explain what is known and asked correctly. Then the completion steps are still not quite right because of a few mistakes and a lack of understanding in understanding the statements in the questions. Also ended up with the wrong conclusion.

Furthermore, the findings related to students in the moderate category were supported by Nurhayati et al. (2013) that students with moderate mathematical reasoning can write down systematic work steps correctly. Students with moderate mathematical reasoning can find patterns to make generalizations(Afinnas & Kurniasih, 2018). Raharjo et al. (2020) confirm that students with moderate reasoning can identify problems, but are incomplete in providing information at the conclusion. Similarly, Saragih (2020) states that students with moderate mathematical reasoning are quite good at concluding, but are less precise in explaining the reasons for the conclusions obtained.

Students with reasoning habits in the low category are not able to fulfill the four stages of mathematical reasoning skills, namely analyzing problems, applying strategies, finding and connecting between mathematical contexts, and reflecting on solutions. According to research from Ardhiyanti et al. (2019) that students with low mathematical reasoning cannot predict how to solve it because they cannot organize information so they cannot solve problems. The findings in this study by Nurhayati et al. (2013) that subjects with low mathematical reasoning cannot make arguments in answering questions and in compiling the steps for working on questions the subject cannot continue their answers. In addition, it is also in line with Ardhiyanti et al. (2019) that students with low mathematical reasoning are not able to draw logical conclusions and provide appropriate reasons for the completion step. Ario (2015) states that students' lack of understanding of mathematical concepts causes students to have difficulty checking the truth of arguments. So a good understanding of concepts is needed in solving mathematical problems..

D. Conclusion

Based on the results and discussion, it can be concluded that students with reasoning habits in the high-category can answer reasoning questions based on realistic math problems. They fulfill the four stages of reasoning habits, namely analyzing problems, applying strategies, finding and connecting between mathematical contexts, and reflecting on solutions. Students with reasoning habits in the moderate category can answer reasoning questions based on realistic mathematical problems correctly but at the stage of finding and connecting between mathematical contexts, and reflecting on solutions, they are still a bit lacking, because they have not been able to determine other mathematical concepts and have not checked the correctness of each step taken. Students with low-category reasoning habits are not able to fulfill the reasoning habit stages at all. Students with low-category reasoning habits in answering reasoning questions based on realistic math

problems are still wrong because they still find it difficult to analyze problems so they are not able to apply strategies, find and connect between mathematical contexts, and reflect on solutions.

The results showed that in the reasoning habits stage through realistic math problems, the problem analysis stage had a very important role in understanding the given realistic math problems. The stages of analyzing problems relate to students' understanding of mathematical concepts, so in this case, the teacher should emphasize learning to improve students' understanding of concepts. One of the lessons that emphasize understanding students' concepts is PMR (Realistic Mathematics Education), and PBL (Problem Based Learning) or problem-based learning. This learning model requires students to form a problem into an abstract mathematical model so that student's understanding of mathematical concepts will increase. The importance of students' reasoning habits in solving realistic math problems. The results of this study are expected to provide an overview of students' mathematical reasoning habits in solving realistic mathematical problems. Researchers provide recommendations for further researchers who are expected to change the criteria of the research subject under study, for example, the reasoning habits of students in terms of learning styles or gender differences.

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The Effect of Creative Thingking Ability and Basic Mathematics Ability Toward Students Problem Solving

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Abstract

This research is an ex post facto research with a quantitative approach. The population in this study were all class VIII of SMP Negeri 2 Ladongi with a total of 73 students. Using total sampling technique so that a total sample of 73 students is obtained. Data collection techniques using tests. Data analysis using multiple regression analysis. The conclusions in this study are as follows: (1) Decryptively, students' mathematics creative thinking abilities are in the quite creative category, students' basic mathematics abilities are in the medium category, students' mathematics problem solving abilities are in the low category; (2) there is a significance influence of students' mathematics creative thinking skills on mathematics problem solving abilities with $t_{hitung} > t_{tabel}$ 8,81 >1,666 and sig < α atau 0,001 < 0,05; (3) There is a significance positive effect on basic mathematics ability on mathematics problem solving ability with $t_{hitung} > t_{tabel}$ or 3,10 > 1,666 and sig < α atau 0,004 < 0,05; (4) There is a significance positive influence on mathematics creative thinking skills and basic mathematics abilities on the mathematics problem solving abilities of class VIII students of SMP Negeri 2 Ladongi with $F_{Hitung} = 65,71$ or $F_{Tabel} = 3,13$ or $F_{Hitung} \geq F_{Tabel}$ and significance = 0.000 < α = 0.05.

Keywords: *Creative Thinking Abilities, Basic Mathematics Abilities, Problem Solving Abilities.*

A. Introduction

During the pandemic all educational activities starting from the elementary, secondary and even tertiary levels were carried out online, without face-to-face meetings between teachers and students. Online learning is a learning that implementation utilizes internet connection in communication between teachers and students. Because learning is carried out online, of course there are many obstacles to be faced, one of which is the lack of supervision from educators to students so that one way is to give assignments at each meeting to develop student knowledge about the material that has been or will be studied (Andri et al., 2022; Rangkuti & Sukmawarti, 2022). This will certainly encourage students to think creatively in order to complete their assignments. Creative thinking, namely the ability to provide various possible answers or problem solving based on the information

provided and spark many ideas for a problem. This understanding focuses on many ways of solving a problem and bringing up new ideas about a problem (Jayanto & Noer, 2017). In the process of solving problems it takes students' ability to think creatively. The ability to think creatively is a person's ability to give birth to something new, both in the form of ideas and concrete works that are relatively different from those that existed before (Rahman, 2012).

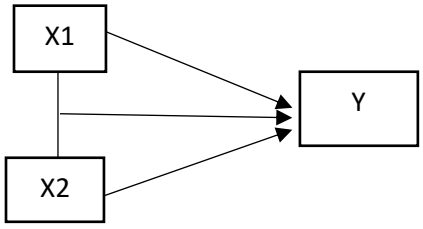
In Solving mathematics problems also requires mastery of the initial concepts that students must know in order to be able to relate to new concepts, because mathematics is an order of organized structure, mathematical concepts are arranged hierarchically and systematically, starting from the simplest concepts to the most complex ones. the most complex concept (Hutagalung, 2017; Sari et al., 2022) . This shows the importance of understanding basic concepts, so special attention is needed for the ability to understand basic mathematical concepts. Lack of mastery of basic knowledge of mathematics will affect students' problem-solving abilities (Ardani & Yulianti, 2022).

Problem solving is also one of the goals of learning mathematics in which there are four aspects of problem-solving skill as follows: (1) understanding the problem, in the aspect of understanding the problem involves deepening the problem situation, sorting out facts, determining relationships between facts and making formulations problem question. Every written problem, even the easiest one, must be read repeatedly and the information contained in the problem is studied carefully, (2) make a problem solving plan, a solution plan is built taking into account the structure of the problem and the questions to be answered. In the process of learning problem solving, students are conditioned to have experience implementing various kinds of problem solving strategies, (3) carrying out problem solving plans. To find the right solution, the plans that have been made must be implemented carefully. Diagrams, tables or sequences are carefully constructed so that the problem solver is not confused. If inconsistencies appear when carrying out the plan, the process must be reviewed to find the source of the difficulty of the problem, (4) look (check) again, while checking, problem solutions must be considered, Polya (Amir, 2015).

In this research, it will be discussed about: 1). Description of students' mathematics creative abilities, basic mathematics ability, and students' mathematics problem solving ability. 2). The simultaneous effect of students' mathematics creative abilities and basic mathematics abilities on students' mathematical problem solving ability. 3). Partial effect of students' mathematical creative abilities on students' mathematics problem solving abilities. 4). Partial effect of students' basic mathematical abilities on students' mathematical problem solving abilitiy.

B. RESEARCH METHODS

The research method used is a quantitative method. This type of research is Ex-post facto research. In this study, there was no treatment or manipulation of the research variables, but rather revealed facts based on measuring the variables that were already existed in the respondents and to find out the causal relationship between the research variables. There are two types of variables used in this study, namely the independent variable (X) and the dependent variable (Y). the independent variables in this study were Students' Mathematical Creative Ability (X1) and Basic Mathematical Ability (X2), while the dependent variable was Mathematical problem solving ability (Y). The research design is as follows:



(Sugiyono, 2013)

Figure 1. Research Design

This research was conducted at SMP Negeri 2 Ladongi in the 2021/2022 Academic Year. The population in this study were all Class VIII students of SMP Negeri 2 Ladongi, totaling 73 students. The sampling technique used is the total sampling technique or saturated sample because the population is not sufficient for 100 respondents. Total sampling is using the entire population as a sample in research (Sundayana, 2020). So that all students of class VIII SMP Negeri 2 Ladongi were included in the research data collection.

The instruments used in this study were the Mathematical Creative Thinking Ability Test, the Basic Mathematical Ability Test, and the problem solving Ability Test. The creative thinking ability test is structured in the form of a description or essay of 3 valid questions, which are measured through 4 indicators, namely: fluency, flexibility, originality, and elaboration. The score given is adjusted to the guidelines for scoring creative thinking skills developed by Bosch. The basic math ability test is structured in the form of multiple choice questions with four alternative answers of 25 valid questions, which are measured using indicators of addition, subtraction, multiplication and division of a number. the score for each answer on the basic math ability test is that correct is given a score of 1 and wrong is given a score of 0. Furthermore, for the problem solving ability test it is arranged in the form of description questions or essays which are developed in the form of story questions as many as 6 valid questions, which measured using indicators: understanding the problem, planning a solution, carrying out the solution, and checking again. The scores given are adjusted to the guidelines for scoring problem-solving skills developed by Polya.

The research data obtained were then analyzed using descriptive statistics and inferential statistics. Descriptive statistics are used to describe categories of students' ability to think creatively, basic mathematical abilities and mathematical problem solving abilities. Furthermore, the inferential statistics performed were multiple linear regression tests using IBM SPSS 20.

C. RESEARCH RESULTS AND DISCUSSION

After conducting descriptive statistical tests, a description of Students' Mathematical Creative Thinking Ability, Students' Basic Mathematics Ability, and Students' Mathematics Problem Solving Ability, which will be presented in the following table:

Table 1: Data Description of students Mathematical Creative Thingking Ability

Category	Interval	Frequency	Percentage
Very Creative	81 ≤ PK	3	4,11%
Creative	61 ≤ PK < 81	32	43,84%
Creative Enough	41 ≤ PK < 61	16	21,92%
Less Creative	21 ≤ PK < 41	10	13,70%
Nor Creative	PK < 21	12	16,43%
Total		73	100%
Average		54,19	

Based on table 1, the ability to think creatively mathematically for students who are in the Creative category is the highest, namely as many as 32 people or 43.84%, but overall out of 73 students the average ability to think creatively mathematically for students of SMP Negeri 2 Ladongi class VIII are in the quite creative category with an average value of 54.19.

Table 2. Data Deskription of Students Basic Mathematics Ability

Kategori	Interval	Frekuensi	Persentase
Very High	78 ≤ KD	3	4.10%
High	62 ≤ KD < 78	23	31,51%
Medium	46 ≤ KD < 62	27	36,99%
Low	30 ≤ KD < 46	15	20,55%
Very Low	KD < 30	5	6,85%
Total		**73**	**100%**
Average		54,34	

Based on table 2, the students' basic mathematical ability in the medium category is the highest, namely 27 people or 36.99%. The average value of the basic ability of mathematics of 73 students is 54.34. This shows that basic ability Mathematics of SMP Negeri 2 Ladongi class VIII is in the medium category.

Table 3. Data Deskription of Students Mathematics Problem Solving Ability

Kategori	Interval	Frekuensi	Persentase
Very High	64,56 ≤ KPM	4	5,50%
High	54 ≤ KPM < 64,56	18	24,70%
Medium	43,7 ≤ KPM < 54	32	43,80%
Low	33,3 ≤ KPM < 43,7	15	20,50%
Very Low	KPM < 33,3	4	5,50%
Total		73	100%
Average		41,92	

Based on table 3, the ability to solve mathematical problems for students who are in the medium category is the highest, namely as many as 32 people or 43.84%, but overall out of 73 students the average mathematical problem solving ability of students of SMP Negeri 2 Ladongi class VIII still in the low category with an average value of 41.92.

Furthermore, inferential statistical tests were carried out to determine the effect of the independent variables on the dependent variable both simultaneously and partially as follows:

1. Simultaneous Test Result (F)

The formulation of the hypothesis tested is as follows:

H_0: $\beta_1 = \beta_2 = 0$ (No effect)

H_1: Not H_0 (There is a joint effect)

With the test criteria, namely:
If $F_{Hitung} < F_{Tabel}$ then H_0 is accepted, If $F_{Hitung} \geq F_{Tabel}$ then H_0 is rejected.

With F table at a significance level α = 0.05 with db1 = 2 and db2 = 73 – 3 = 70 of 3,13.

Table 4. Anova analisys results with SPSS

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18256,566	2	9128,283	65,718	,000[b]
	Residual	9723,074	70	138,901		
	Total	27979,641	72			

a. Dependent Variable: Problem Solving Ability (Y)
b. Predictors: (Constant), Basic Math Ability (X2), Creative Thingking Ability (X1)

Based on table 4, obtained F_{Hitung} = 65,71 dan F_{Tabel} = 3,13 or $F_{Hitung} \geq F_{Tabel}$ and significance= 0.000 < α = 0.05 then H0 is rejected.Thus it can be concluded that there is a significance influence on the ability to think creative mathematics and basic mathematical abilities on the ability to solve mathematical problems in class VIII students of SMP Negeri 2 Ladongi.

To see the magnitude of the value of determination or the simultaneous effect of the variables on the ability to think creatively in mathematics and basic ability in mathematics on the ability to solve mathematical problems is presented in the following table:

Table 5. Model Summary Results with SPSS

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,808[a]	,652	,643	11,78563

a. Predictors: (Constant), Basic Math Ability (X_2), Creative Thingking Ability (X_1)

Based on table 5, the magnitude of the coefficient of determination R square obtained is 0.652. The meaning of these coefficients is that the influence exerted simultaneously by the variables of mathematical creative thinking ability and basic mathematical ability is 65.2% while 34.8% is influenced by other variables not examined in this study.

2. Partial Test Results (T)

Research hypothesis:

$$H_0: \beta_i = 0, \text{i} = 1, 2$$
$$H_1: \beta_i \neq 0, \text{i} = 1, 2$$

With the test criteria,

H_0 is rejected if $|t_{hitung}| \geq t_{tabel}$ or significance value < α at level α = 0,05

H_0 is accepted if $|t_{hitung}| < t_{tabel}$ or significance value > α at level α = 0,05

Tabel 6. Corelation Coeficient Analysis Result For Y and X_1 when X_2 Constant

Correlation coefficient (r)	Coefficient of Determination (KD)	t_{hitung}	Signifikasi	t_{tabel}
0,723	52,2%	8,81	0,001	1,666

Based on table 6, it can be seen that $t_{hitung} > t_{tabel}$ or 8,81 >1,666 and sig < α or 0,001 < 0,05, it can be concluded that there is a significance influence between the ability to think creatively in mathematics on the ability to solve mathematical problems in class VIII students of SMP Negeri 2 Ladongi . The magnitude of the coefficient of determination R square obtained is 0.522. The meaning of the coefficient is that the influence of mathematical creative thinking ability is 52.20%. In the process of solving problems, students need the ability to think creatively about a mathematical concept. The ability to think creatively is a person's ability to give birth to something new, both in the form of ideas and concrete works that are relatively different from those that existed before (Rahman, 2012), so that the ability to think creatively really needs to be improved by students so that they can complete tasks in lesson.

Tabel 7. Corelation Coeficient Analysis Result For Y and X_2 when X_1 Constant

Koefisien korelasi (r)	Koefisien determinasi (KD)	t_{hitung}	Signifikasi	t_{tabel}
0,331	11,00%	2,96	0,004	1,666

Based on table 7, it can be seen that $t_{hitung} > t_{tabe}$ or 3,10 > 1,666 and sig < α atau 0,004 < 0,05 , it can be concluded that there is a significance influence between basic mathematical abilities on the mathematical problem solving abilities of class VIII students of SMP Negeri 2 Ladongi. The magnitude of the coefficient of determination R square obtained is 0.11. The meaning of these coefficients is that the influence given by basic mathematical abilities is 11%. The basic ability of mathematics is an important thing for students to have where the basic ability of mathematics is the initial foundation that will be used as a provision for students to receive higher concept mathematics learning material. This is in accordance with the opinion of Slameto (Mardiyanti and Abdulah, 2018: 50) the basic abilities that students have before starting a new lesson, have an influence on the ability of students to understand the subject matter they will face. Therefore, the basic abilities of mathematics need special attention to these basic abilities because these basic abilities will become the initial foundation for students to solve problems related to mathematics.

D. CONCLUSIONS

Students' mathematical creative thinking abilities are in the quite creative category with an average score of 54.19, students' basic mathematical abilities are in the moderate category with an average score of 54.34, students' mathematical problem solving abilities are in the low category with an average score 41.92. There is a significance influence on the ability to think creatively in mathematics and basic mathematical ability on the ability to solve mathematical problems in class VIII students of SMP Negeri 2 Ladongi with a determination value of 65.20%, while 34.8% is influenced by other variables.

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