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Research Article

Development of Triangular Learning Media Based on Adobe Animate CCwith ADDIE Learning Design

Nurfajar Wahyuliana[1]**, Dedek Andrian***[2]

[1]Education Mathematics Department, Universitas Islam Riau, Indonesia, 28284
[2]Education Mathematics Department, Universitas Islam Riau, Indonesia, 28284
✉Corresponding Author: dedekandrian@edu.uir.ac.id, | Phone: +62852-64537478

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ABSTRACT

This study aims to systematically develop technology-based interactive learning media to improve students' problem-solving and reasoning skills. This research is development research, namely the development of learning media based on Adobe Animate CC with ADDIE learning design on triangle material. The subjects of Adobe Animate CC learning media development areSMPN Bengkalis Regency students. The research instrument used is a validity assessment sheet for experts and practitioners. Data analysis uses descriptive statistics to see the percentage of answers from experts and practitioners and then compares them with standards of validity and practicality. The development results show that the created Adobe Animate CC has illustrations that can attract students' attention and interest (motivation) in learning mathematics. Experts and practitioners assess Adobe Animate CC learning media in the correct category with an average value of 81.55%. Experts and practitioners also estimate that Adobe Animate CC learning media is in the practical type, averaging 84.03%.

Keywords: *Macromedia Flash 8 ,learning Media, similarity and congruence*

1. INTRODUCTION

Mathematics is defined as the science of logic, numbers, and space that requires reasoning. Mathematical reasoning skills can help overcome students' difficulties in learning mathematics related to logic, numbers, and space (David & Dedek, 2022). Mathematics is a subject considered difficult at school because learning it requires a high level of thinking, so some students say mathematics is a complex and dull subject (Dila & Zanthy, 2020). This is reinforced by the findings in the field that the mathematical ability of stu- dents in Indonesia is still relatively low (Mahadewi et al., 2020). Mathematical reasoning is reasoning about mathe- matical objects needed to draw a conclusion or make a new statement based on several statements whose truth has been proven or assumed previously (Kusumawardani et al., 2018).Mathematics is a material that contains regular patterns and organized structures in one area of life, namely studying the nature of understanding the patterns of change that occur in the real world and human thought (Dwidarti et al., 2019). Given the importance of mathematics, mathematics needs to be understood and mastered by all levels of society, espe- cially in schools (Dhanil & Mufit, 2021).

The learning process will be difficult to succeed if there is no guidance from the teacher; this is because to produce effective learning, students must also have good behavior (Dedek Andrian et al., 2020). This is of course a challenge for teachers to still be able to create a fun, inter- esting and active learning atmosphere (Yulia & Putra, 2020). Teachers have a role in supervising and evaluating students'abilities and trying to improve learning so students can achieve satisfactory results (Samsudin, 2020). It has beenfound in the field that there are still teachers who cannot create good learning conditions because of the teacher's lack of knowledge and skills. (Buchari, 2018). In addition, in face-to-face learning before the COVID-19 pandemic, teach- ers only used some teaching aids, such as still images and transparency media in learning mathematics. The use of these teaching aids is also not used routinely in learning, and this is due to the lack of ready-to-use media (Amin & Sumarni, 2021).

One solution that can be considered is by increas- ing technology ability (Fathonah & Bukhori, 2021). The way to create an atmosphere of learning mathematics to be fun is to create a learning media that can attract the attention of students (Abdullah & Yunianta, 2018). The role of the mediain the learning process for students is significant. In additionto making it easier for teachers to teach, suitable media can help students understand the material being taught (Rachman, 2018). Exciting and interactive learning mediacan arouse students' motivation and interest in studying the material provided by the teacher so that it will make it easi- er for students to understand it (Marthani & Ratu, 2022). The existence of the latest innovations in learning mathe- matics by utilizing learning media can arouse students' de- sire to learn mathematics and reduce students' anxiety and boredom in learning mathematics. (Yuliana et al., 2018). The benefit of learning media is to provide guidelines for teach- ers to achieve learning objectives so that they can explain learning materials in a systematic order. Learning mediahelps in presenting exciting material to improve the quality of learning. Learning media that are designed to the maxi- mum can increase students' motivation and interest in learning so that students can think critically and analyze the subject matter given by the teacher properly (Ferdiansyah; etal., 2020).

One of the exciting media to be applied in learning is Adobe Animate. Adobe Animate is one of the many soft- ware that can produce new features that can be used in the field of education by combining the concept of learning with Animate CC and it is hoped the students interest and moti- vation will be increased maximally after studying with Adove Animate CC.

One of the learning models that can be done to improve student learning outcomes is the ADDIE learning model (Ulum et al., 2020). ADDIE learning design is a learning de- sign model that uses five stages/steps in its learning, namely Analysis, Product Design, product development, and productvalidation stages Product Development, Implementation,Evaluation (Cholifah et al., 2021). The development process can be carried out by testing a team of experts, and research subjects individually, on a limited scale, and on a wide scale (in the field), and revisions are made to perfect the final product. Although the development procedure is relatively short, it includes a testing and revision process so that the developed product can meet the criteria for a good product and is empirically tested (Cahyadi, 2019). It is hoped that after participating in learning using the ADDIE learning design, which is integrated with Adobe Animate, students will have alearning experience. Students are expected to obtain satisfac- tory final results. Learning with ADDIE design can increase the effectiveness and skills of students. this can create a learning process that is not monotonous so that students are interested in learning and follow the maximum learning that has been designed. Based on some of the problems above, developing appropriate or valid media based on Adobe Ani- mate CC with ADDIE learning design is necessary.

2. Research Method

The research method used in this research is the researchand development (R&D) method. The R&D method is a research method that produces the latest innovations,whether in the form of a new product or developing an ex- isting product to make it more attractive and follow thelearning objectives of a particular subject (Muqdamien et al., 2021). The ADDIE model consists of 5 stages: Analyze, Design, Development, Implementation, and Evaluation. This ADDIE model can be used as a research method to de- velop teaching materials and others. The product will be developed and produced in Adobe Animate CC learning media, which will be applied through triangle material to class VII at SMPN in Bengkalis Regency. The selection of triangle material is easier for teachers to explain and provideexamples related to triangles, so teachers do not need to bring props and other media.

The data collection technique in this study is to provide a valid- ity sheet to the expert validator. The data collection instru- ments in this study consisted of material and media expert validation sheets, practicality sheets, and student response questionnaires. The data obtained will be calculated in a quantitative descriptive way that refers to the validity stand- ard Zakiy et al., (2018) that can be checked in Table 1.

Table 1. Expert Assesment Score

Criteria	Score
Very Good (SB)	4
Good (B)	3
Quite Good (C)	2
Poly (KB)	1

Furthermore, the results of the expert validator's assessmentof the learning media listed on the validation sheet will be analyzed using the following formula.

Validation Persentage = (Acquired Score :Maximal Score) x 100%

For the criteria for the level of validity of the learning media used, it can be seen in Table 2.

Nilai	Interval	Keterangan
4	85%<Score ≤100%	Very valid, can be used without revision
3	70%<Score ≤85%	Valid, can be used with minor revision
2	50%<Score ≤70%	Quite valid, can be used with mayor revision
1	0%<Score ≤50%	In valid, can not be used

The development procedure starts with a preliminary study by selecting materials, learning media, and learning design models. Furthermore, development is carried out by design- ing Adobe Animate CC learning media which includes sever- al things, including determining the material to be applied in Adobe Animate CC, introduction to learning media, content standards and competency standards, materials, and ques- tions. Then the validity test is carried out by media and mate- rial experts for the research and development products that have been completed. At this stage, it is done by testing whether or not the Adobe Animate CC learning media is be- ing developed along with the weaknesses and shortcomingsof Adobe Animate CC learning media using the ADDIE learning model. After passing the product validity test stage, the weaknesses and shortcomings of the Adobe Animate CC learning media are visible. At this stage, improvements and improvements were made to the Adobe Animate CC learningmedia. Product revisions are based on analysis and validity tests with various criticisms and suggestions from validator experts.

3. Result and Analysis

3.1 Analysis State

The development procedure starts with a preliminary study by selecting materials, learning media, and learning design models. Furthermore, development is carried out by de- signing Adobe Animate CC learning media which includes several things, including determining the material to be ap- plied in Adobe Animate CC, introduction to learning media, content standards and competency standards, materials, and questions. Then the validity test is carried out by media and material experts for the research and development products that have been completed. At this stage, it is done by testing whether or not the Adobe Animate CC learning media is being developed along with the weaknesses and shortcomings of Adobe Animate CC learning media using the ADDIE learning model. After passing the product valid- ity test stage, the weaknesses and shortcomings of the Ado- be Animate CC learning media are visible. At this stage, improvements and improvements were made to the Adobe Animate CC learning media. Product revisions are based on analysis and validity tests with various criticisms and sug- gestions from validator experts.

3.2 Design Stage

The design stage is the core stage of this development re- search, where the media developed at this stage is designed. Several things are designed at this stage, among others: (1)the development of triangular material in the media; (2) me- dia background or theme with Adobe Animate CC, (3) dis- tinctive characters on media, (4) media working, (5) media name determination. This media uses the theme of hill scen- ery with several triangular-shaped images after the material isdeveloped. The concept follows the current Z generation, which cannot be separated from technology.

3.3 Development Stage

This media development uses Adobe Animate CC 2018 soft- ware. Adobe Animate is a graphic software that creates vari- ous animations, interactive websites, learning media, and games. The display of buttons and sharing images on this media was created using Coreldraw 2017, while the material and answer choices were made using Microsoft Office Power word 2010. The opening page has a display that can be seenin Figure 1. On this page, there is the title of the material be- ing developed, the sound icon from this media's background music, and the icon to exit media. After that, click the button (‣) at the bottom center to go to the main menu.

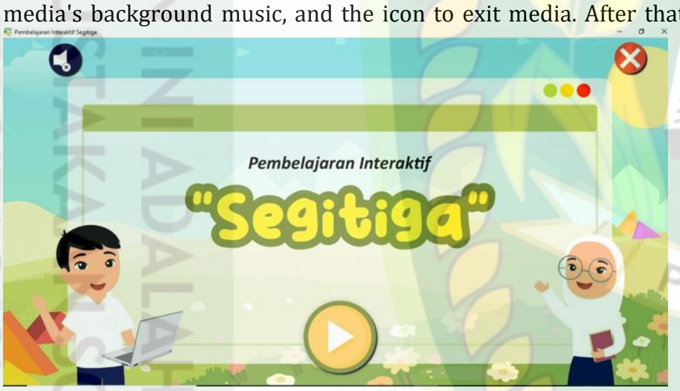

Figure 1. Home Page View

After pressing the button (‣) The main menu will appear on this learning media. This display contains five main menus, namely instructions for use, core competencies (KI), basic competencies (KD), materials, quizzes, and profiles of this media developer. The main menu display can be seen in Fig- ure 2

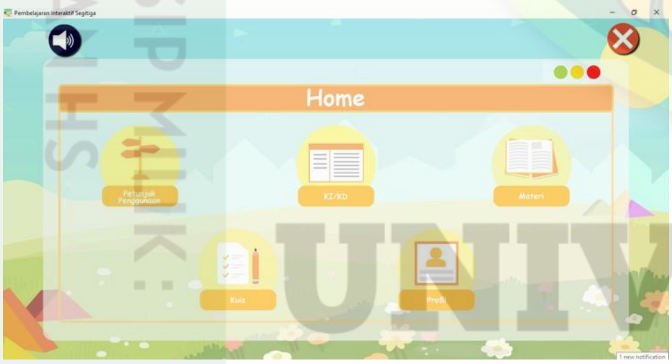

Figure 2. Home Page View

The display on the user manual can be seen in Figure 3. Inthis display there is an explanation of the function of each button on each page.

Figure 3. User Guide Page Display

The display on the KI/KD page can be seen in Figure 4. The display on this page describes the Core Competencies (KI)/Basic Competencies (KD) in the triangle material.

Figure 4. KI/KD Page Display

The display of the material page can be seen in Figure 5. This view conveys the triangle material that will be taught.

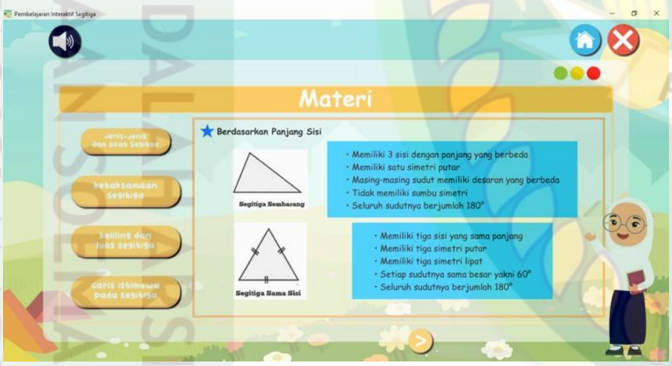

Figure 5. Material Page View

The quiz page display can be seen in Figure 6. When pressing the quiz icon, a display will appear that requires students to fill in their identity in the form of name and attendance num- ber. start icon to direct students to the quiz questions pre- sented.

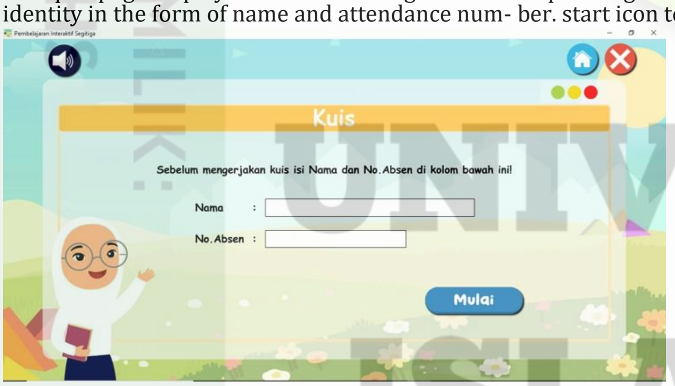

Figure 6. The quiz page display

After pressing the start icon, the quiz questions page will be displayed as shown in Figure 7. In this display, students can choose one of the answers provided. After students choose the answer that they think is correct, a button (›) will appear on the quiz question display to direct students to the next question. After completing the quiz questions, the results obtained will be displayed.

Figure 7. Quiz Question Page Display

The profile page view can be seen in Figure 8. This viewdescribes the profile/identity of this media developer.

Figure 8. Profile Page Display

The media that has been developed is then assessed by media experts, material experts, and teachers. This assess-ment aims to get criticism and suggestions that are useful in improving the media before it is applied to learning.

3.4 Evaluation Stage

This evaluation stage aims to find out the weaknesses of Adobe Animate CC-based learning media, learning out- comes, and the arrangement of plans in learning. The resultsof this stage are used as the basis for improving the Adobe Animate CC learning media in the development of triangle learning media.

he analysis of student opinions indicates that Adobe Ani- mate CC media can help students learn triangle material. Anattractive and easy-to-understand design can increase stu- dent learning motivation. Overall, the Adobe Animate CC learning media received a positive response from students. One of the student responses is that this learning media has an attractive appearance, is easy to use, and attracts student learning interest.

Table 3. Media Expert Validation Assessment Results

Assessment Component	Sum of Assess-ment Score (%)	Criteria	Conclusion
Material	72,22%	Valid	Worth using with a little revision.
Ilustration	93,75%	Very Valid	Can be used without revision.
Quality and Media Display	75%	Valid	Worth using with a little revision.
Attractiveness	87,5%	Very Valid	Can be used without revision.

The results of the validity test in terms of the media aspect resulted in a validity index of 82.11%, included in the valid category, and this is because the media has an illustrated and attractive appearance that can attract students to be moremotivated in learning and the media can also be used offline on all desktops.

Table 4. Results of Material Validation by Expert

Assessment Component	Sum of Assessment Score (%)	Criteria	Conclusion
Content Eligibility	80,5%	Valid	Learning media can be used with a little revision.
Language	87,5%	Very Valid	Can be used without revision.
Presentation	75%	Valid	Learning media can be used with a little revision.

The results of the validity test in terms of material aspects produce a validity index of 81%, which is included in the valid category. This is because the material in this media has coverage by KI/KD and diversity of questions. This indicates that Adobe Animate CC media is valid for use with minor revisions.

Table 5. *Teachers Response on Adobe Animate CC learning media*

Validator	Score Average	Criteria
Validator 1	84,72 %	Practical
Validator 2	83,33 %	Practical

As seen in Table 5 above, it can be concluded that the assessment of practitioners (responses/responses) by experts and expert teachers on Adobe Animate CC learning media obtained an average score of 84.72% and 83.33% with practical criteria. As for seeing the results of the assessment on each point of the Adobe Animate CC learning media in Table 6.

Table 6. Teacher's Response to Each Point Against Adobe Animate CC Learning Media

Validator	Development Product	Assessment Score (%)	Criteria
Validator 1	Media Display	87,5 %	Very Practical
	Media Content	83,33 %	Practical
	Attractiveness	83,33 %	Practical
Validator 2	Media Display	87,5 %	Very Practical
	Media Content	75 %	Practical
	Attractiveness	87,5 %	Very Practical

Based on the results listed in Table 6, the number of practicality test scores on Adobe Animate CC learning me- dia can be concluded that the average number of assessmentscores by teachers on the use of Adobe Animate CC learningmedia with ADDIE learning design is 84.025% with practicalcriteria and learning media Adobe Animate CC with ADDIElearning design can be used in learning.

The results of observations during the research anddevelopment of Adobe Animate CC media on triangle ma- terial carried out by researchers obtained several findings; ingeneral, students felt interested and enthusiastic about the Adobe Animate CC media. This was because the media de- veloped was interesting, not boring, and became an arena for competition between students working on problems in the media. In the teacher's opinion, the Adobe Animate CC media on triangle material that can be played on the desk- top can add insight to teachers and students about media that can be used in learning.

Based on the expert and practitioner validation test, the learning development product was declared valid and prac- tical to be used as a learning medium in improving students' reasoning abilities in solving problems systematically. Valid and practical the learning media will give the best practice in learning activities (Danielsson & Wiberg, 2006; Rochmad, 2012). Valid and practical learning media become the best issue to implement a maximum of learning activities (Spikol & Eliasson, 2010). It should be the attention of every educa tional stakeholder because learning that is run without the truth procedure will generate bad results (Thomas et al., 2015).

Every educational stakeholder is needed to think about how to give valuable experience to students, and this only can be carried out by developing the new educational product like the interactive learning media (Root et al., 2020). Developing media will be an effective strategy to get the best learning practice so students can feel something new that makes their motivation and interest better than before.

4. Conclusion

Adobe Animate CC-based interactive learning media with the ADDIE learning model at SMPN Bengkalis District on the Triangle material produces valid and practical learning media.The media is suitable for learning activities, easy for teachers to use, and helps students understand concepts. Adobe Ani- mate CC learning media is limited to triangle material. Therefore, further researchers can develop interactive learn- ing media based on Adobe Animate CC on other mathematics materials. The average press and material validation results are 81.55%, with valid assessment criteria. The average num- ber of practicality test scores for development products is 84.03%, with practical criteria and good learning media. Based on the media validation criteria, the Adobe Animate CC learning media with the ADDIE learning model is effec- tively used in learning.

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Research Article

Improving students' ability to understand mathematical concepts through peer tutor type cooperative learning models in PP. Syariful Hidayah

Kartika Harahap, Nurlina Ariani Harahap✉

Faculty of Teachers Training and Education, Universitas Labuhanbatu, Sumatera Utara, Indonesia
✉Corresponding Author: nurlinaariani@yahoo.com

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ABSTRACT

The purpose of this study was to determine the increase in mathematics learning outcomes through peer tutor type cooperative learning models in class IX.1 PP students. Shariful Hidayah. This study used three rounds of classroom action research. Each round consists of four stages: design, activity and observation, reflection, and revision. The target of this research is class IX.1 PP students. Shariful Hidayah. The data obtained is in the form of formative test results, observation sheets of teaching and learning activities. From the results of the analysis it was found that the learning outcomes of students experienced an increase from the pre-cycle, cycle I to cycle II, namely, pre-cycle (53.52%), cycle I (70.67%), and cycle II (79.74%). The conclusion of this study is that the peer-tutor-type cooperative learning model has a positive effect on the learning outcomes of PP students. Syariful Hidayah, as well as this learning method can be used as an alternative to learning mathematics.

Keywords: Cooperative peer tutor type; Mathematics and Learning; Outcomes

1. INTRODUCTION

Mathematics is a universal science that underlies the development of modern technology and is important in various disciplines and develops human thinking power. In everyday life mathematics plays an increasingly significant role. However, if you look at the teaching of mathematics in both elementary and secondary schools, it is still far from expectations. The aim is to prepare students to be able to deal with changing circumstances and be skilled and capable of responding to them. While learning is a set of actions designed to support the learning process of students, taking into account extreme events that contribute to a series of internal events that take place experienced by students. (Winkel in Siregar and Hartini Nara, 2010). Achieve the minimum completeness criteria that have been set, namely 75, as follows: students who get scores above/equal to 75 are only 18 people with a percentage of 51.43%. And students who scored less than 75 totaled 17 people. This figure is still far from the expected indicator of success, namely 85% of students who score above 75. In fact, in carrying out teaching and learning activities, teachers are still dominant in applying conventional learning processes (Trianto, 2009). In the conventional learning process, the classroom atmosphere tends to be teacher-centered so that students become passive.

Based on this definition, the learning process in class tends to be monotonous which causes low learning outcomes. Whereas according to (Wena, 2009) the use of strategies in learning activities is to facilitate the learning process so as to achieve optimal results. In line with the opinion above, Dick and Carey (in Sanjaya, 2008) also stated that the learning strategy is a set of learning materials and procedures that are used together to generate learning outcomes for students. According to observers as a subject teacher in PP. Syariful Hidayah that the learning process in schools tends to be centered on the teacher, where the teacher only gives or transfers information or knowledge to students, so that students only receive it passively. Sometimes students answer the questions correctly but they cannot reveal the reasons for their answers. In students can use the formula but do not know where the formula comes from and why the formula is used. Such a situation may occur because in the learning process students are not given the opportunity to express ideas and reasons for their answers. As a consequence, students become inactive in learning and this also has an impact on learning outcomes for students who on average have not yet reached the KKM score of 75. For this reason, the teacher must think about which strategy is the most effective and efficient that can help students In achieving the goals that have been formulated, the right selection is directed so that students can carry out optimal activities. One of them is using active learning strategies, cooperative learning systems with pair learning techniques, in the learning process, especially in mathematics.

According to Trianto (2009) Cooperative learning arises from the concept that students will find it easier to find and understand difficult concepts if they discuss with their friends. Students routinely work in groups to help each other solve complex problems. The purpose of forming these groups is to provide opportunities for all students to be actively involved in thinking processes and learning activities. While working in groups, the task of group members is to achieve learning mastery. With this responsibility, peer tutors also have the right to receive additional lessons from the teacher, including the right to read and borrow all the books used by the teacher and other books. Based on the description above, the authors are interested in conducting research on "Efforts to Improve Mathematics Learning Outcomes Through the Cooperative Learning Model of the Peer Tutor Type in Class IX.1 PP students. Shariful Hidayah".

Based on the description above, the problem formulation in this study is: how to increase the results of learning mathematics through cooperative learning models of the peer tutor type for students in class IX.1 PP. Syariful Hidayah? In accordance with the formulation of the problem that has been stated above, the aim of this research is to find out the increase in mathematics learning outcomes through the peer tutor type cooperative learning model for students in class IX.1 PP. Shariful Hidayah. The implementation of classroom action research is very beneficial for students to improve learning outcomes, learning process activities for students so that they can increase students' understanding of the importance of evaluating various government systems. In essence, in the educational process in schools, learning is a component of educational science with regard to the goals and references of interaction materials. The success or failure of educational goals depends on how the learning process experienced by children as students. Morgan (in Syaiful Sagala, 2009) says that learning is any relatively permanent change in behavior that occurs as a result of training or experience.

Many efforts have been taken to improve the quality of the country's education, starting from conducting training to improve the quality of teachers, renewing the curriculum and improving school facilities and infrastructure. Mathematics is a science that is needed to train logic in thinking and elaboration skills (Anggriyani et al. 2021). In mathematics, the description of a term is carried out carefully, accurately and accurately by utilizing the use of many symbols and the language of symbols about ideas rather than sounds (Andriani, Suastika, and Sesanti 1970). Mathematics has theories and concepts that are appropriate in everyday life (Khairani and Febrinal 2020). Regularity in learning and understanding mathematics needs to start from the simplest, intermediate, to difficult knowledge (Susdarwono 2020). According to Wati in (Ritonga, Julyanti, and Hasibuan 2021) In learning mathematics students are not only taught to memorize mathematical formulas but also to solve problems using mathematics related to mathematics around their lives. Skills in creative thinking are level skills. high or also called High Order Thinking. High Order Thinking. is part of the 2013 curriculum goals that are mandatory for students to master (Gais and Afriansyah 2018). One of the skills that is considered important for students is mathematical thinking skills (Pangestu and Hasti Yunianta 2019). Mathematical creative thinking ability is the ability to think with the aim of creating or discovering new ideas that are different, not common, original that brings definite and precise results (Abidin, Rohaeti, and Afrilianto 2018). The ability to think creatively in mathematics means that it can be said to be an effort of a learner to be able to find solutions through alternative ideas/ideas in solving or solving problems related to mathematics (Faelasofi 2017).

Sudjana (1999) argues "Learning outcomes are abilities possessed by students after they receive their learning experience. According to Dimiyati and Mudjiono (2006) that learning outcomes are the result of an interaction of teaching or learning. From the teacher's point of view, the act of teaching ends with the process of evaluating learning outcomes. Mathematics is expected to form critical, creative, honest and communicative attitudes in students (Depdiknas, 2004). "Model can be interpreted as a conceptual framework that is used as a guide in carrying out activities" (Sagala, 2010). "The learning model can be interpreted as a conceptual framework that describes and describes systematic procedures in organizing learning and learning experiences to achieve certain learning goals, and serves as a guide for teaching planning for teachers in carrying out learning activities" (Sagala, 2010). Cooperative learning (Cooperative Learning) is a learning model in which students study in small groups that have different levels of ability (Ibrahim 2009). According to Lie, cooperative learning is a teaching system that provides opportunities for students to work with fellow students in structured tasks. On the other hand, according to Slavin, cooperative learning is a learning model in which students learn and work collaboratively in small groups whose members consist of 3 to 5 people, with a heterogeneous group structure. Peer tutor type cooperative learning strategy is a learning model that prioritizes models of cooperation between students in a group to achieve common goals that will be guided by peers who have good achievements. For children who have feelings of fear or are reluctant to ask the teacher, they can ask their friends directly without fear, because with their friends, they will feel happy

2. RESEARCH METHOD

This research is included in the type of classroom action research (CAR). The main characteristic of classroom action research is that there are certain actions to improve and enhance the learning process in the classroom. The classroom action research used was participant research in which the researcher was directly and fully involved in the research from the beginning to the end of the study. This research was conducted in PP. Syariful Hidayah, this school was chosen as a place for research because the researcher is a mathematics teacher at the school. The time for this research to be carried out was from September to November for the 2022/2023 school year, because in this school year researchers are mathematics teachers in PP. Syariful Hidayah, the subject matter presented was "Strategic comparison". The subjects referred to as action in this study were class IX.1 PP students. Syariful Hidayah, totaling 35 students. They were students of class IX.1 semester I for the 2022/2023 academic year, while the participants involved in this study were class teachers and other colleagues. The indicator of the success of this study was using the results of the KKM benchmark learning value of 85% and there had been an increase in students' motivation and interest in learning mathematics. This study uses a class action research method (CAR). This is adapted to the characteristics of classroom action research, namely the problems to be solved originate from problems of learning practice in class or depart from factual practice problems. This classroom action research model refers to the Kemmis and MC Taggart models which describe that action is described as a dynamic process from the aspects of planning, action *(implementation),* observation *(observation),* reflection. Data collection in this study was carried out using field note techniques, student worksheets, written tests.

3. RESULTS AND DISCUSSION

3.1 Results

Table 1. Recapitulation of Pre-Cycle Test Results

Descriptions	Pre-Cycle
Average test score	77.00
The number of students who complete learning	19
The number of students who do not complete learning	16
Percentage of learning completeness	51.43
Percentage of incomplete learning	48.57

Based on **Table 1**, it can be seen that students whose scores reach the minimum completeness criteria that have been set are 75, as follows: students who get scores above/equal to 75 are only 19 people with a percentage of 51.43%. And students who scored less than 75 totaled 16 people. This figure is still far from the expected indicator of success, namely 84% of students who score above 75.

Table 2. Recapitulation of average test results in cycle I

No.	Descriptions	Cycle I
1	Average test score	75.05
2	The number of students who complete learning	25
3	The number of students who do not complete learning	10
4	Percentage of learning completeness	68.65
5	Percentage of incomplete learning	34.29

Based on **Table 2**, it can be explained that by applying learning using the peer tutor type cooperative learning model, the average value of student learning outcomes is 75.05 and learning completeness reaches 68.65% or only 25 students out of 35 students who have completed learning. These results indicate that in the first cycle classically the students have not completed 40.38% which is smaller than the desired percentage of completeness which is equal to 86%. This is because students are still not able to adjust to the new learning model and teachers do not train students' cooperative skills in learning activities.

Table 3. Recapitulation of average test results in Cycle II

No.	Descriptions	Cycle II
1	Average test score	80.25
2	The number of students who complete learning	34
3	The number of students who do not complete learning	1
4	Percentage of learning completeness	79,74
5	Percentage of incomplete learning	12.54

Based on **Table 3**, the average value of the formative test is 80.25 from 35 students who have completed 34 students and 1 student has not yet achieved learning mastery. So classically the learning completeness that has been achieved is 79.74% (including the complete category). The results in cycle II experienced a better improvement than cycle I. The increase in learning outcomes in cycle II was influenced by an increase in students' ability to learn the subject matter that had been applied so far. This is influenced by the teacher's ability to manage the teaching and learning process during ongoing learning activities. Based on the results of this study, it shows that learning using peer tutor cooperative learning models has a positive impactin improving student learning outcomes. This can be seen from the increasingly solid understanding and mastery of students towards the material that has been conveyed by the teacher so far the learning completeness has increased from the learning outcomes before the action and after the action, namely; pre cycle (53.52%), cycle I (70.67%), and cycle II (79.74%). In cycle II the classical learning completeness of students has been achieved and has experienced a very good increase.

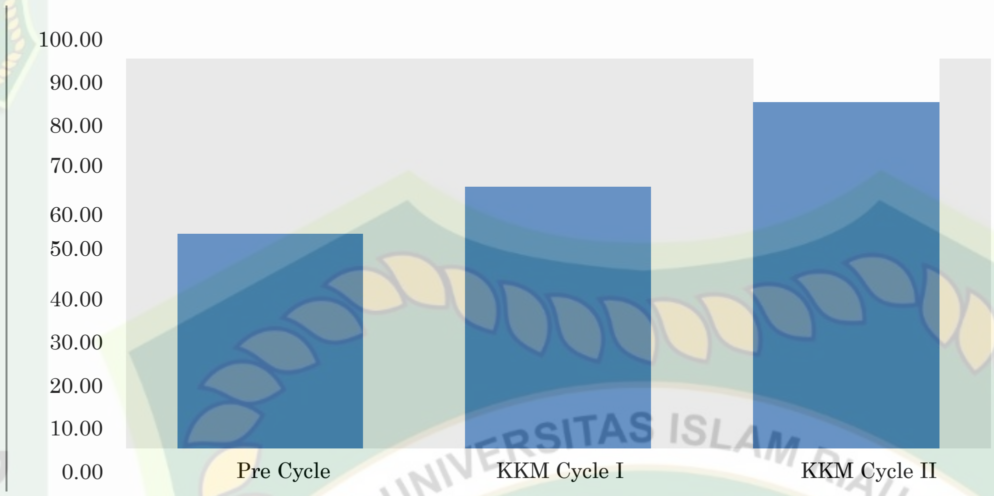

Figure 1. Diagram of Learning Outcomes Before Action and After Action

4. CONCLUSION

Learning using the peer tutor type cooperative learning model has a positive impact on improving student learning outcomes which is marked by an increase in student learning mastery in each cycle, namely pre-cycle (53.52%), cycle I (70.67%), and cycle II (79.74). The application of learning using the peer tutor type cooperative learning model has a positive effect, which can improve student learning outcomes as indicated by the observations that the observer teacher sees, and students are interested in using the peer tutor type cooperative learning model so that they become motivated to learn. To carry out learning requires adequate preparation.

AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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Research Article

Effect of problem-based learning approach on students' achievement in trigonometry

Limann Kwashie Amedume[1], Hamidu Ibrahim Bukari[2]✉ & Romuald Koffi Mifetu[3]

[1,3] Hohoe E.P Senior High School, Volta, Ghana
[2] Department of Mathematics/ICT, Bagabaga College of Education, Tamale, Ghana
✉Corresponding Author: ibrahimbukari@gmail.com

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ABSTRACT

This study investigated the effect of the problem-based learning ap-proach on students' achievement in Trigonometry in Senior High Schools in the Hohoe Municipality of Volta region in Ghana. The re-search was a mixed method that employed a quasi-experimental non-equivalent comparison group design to compare the achievements of students exposed to a problem-based learning approach and that of the traditional approach. A convenient sampling technique was used to select two Senior High Schools in the Hohoe Municipality which served as comparison and experimental groups respectively. Data was collected using instruments such as questionnaires, trigonometric achievement tests, and semi-structured interviews. A sample of 94 students comprising of 45 in the comparison group and 49 in the ex-perimental group was used for the study. The findings revealed that the problem-based learning approach is very effective for teaching and learning of trigonometry since it promoted students' active participa-tion in the instructional process, content mastery and improved their creative thinking and independent problem-solving skills.

Keywords: problem-based learning; senior high school students; achievement; trigonometry

1. INTRODUCTION

The importance of mathematics education is crucial for the welfare of people. Effective mathematics instruction provides students with several advantages, including the development of their critical thinking, reasoning, and problem-solving skills. The issues with the Ghanaian educational system are very broad in kind, and they include issues with teaching mathematics. The mathematics achievement of Senior High School students has recently received more attention. If students are to become the problem solvers of the future, they must be trained to transcend beyond simple memorizing of facts and equations and low level comprehension. This is because modern technology and scientific advances are being experienced on a global scale. The teaching methods such as lectures, demonstration among others used in many Senior High Schools have not brought about the expected learning outcomes in the development of trigonometric concepts among Senior High School (SHS) students. This has resulted in SHS students' low achievement in trigonometry in the West African Examination Council (WAEC) Examination. The Chief Examiner's report of the West African Examination Council (WAEC, 2016, 2018) on SHS Core Mathematics 2 outlined students' difficulties in solving trigonometric problems. Among the discoveries made includes students demonstrating weaknesses in understanding and solving trigonometric problems. There is also empirical evidence that many Senior High School students in Ghana have serious difficulties when solving trigonometric problems. They make a series of errors in the process (Mensah, 2017).

Recent studies (Kaharuddin, 2018; Lozinski, Poon & Spano, 2017; Masitoh & Fritriyani, 2018) conducted from other countries on some mathematics topics found that the PBL approach improved students' learning and understanding, and their achievement level in the subject. Many students in Ghana have a very difficult time solving arithmetic problems, especially those involving trigonometry. They make numerous mistakes throughout the process (Mensah, 2017). According to Gyan, Ayiku, Atteh, and Adams (2021), comprehending trigonometry is a must for understanding fields like architecture, physics, surveying, and engineering branches that have a substantial impact on human existence. One of the constructivist methods is having students participate in the conception of concepts. Bukari (2019) describes problem-based learning as a constructivist pedagogical approach to instruction in which students work together in smaller groups to find solutions to difficult problems. PBL encourages students to become self-directed learners, critical thinkers, and effective problem solvers, which helps them retain mathematical concepts and their applications to real-world situations for the rest of their lives (Bukari & Asiedu-Addo, 2019).

Teaching students to retain mathematical concepts as well as to understand the reasons behind and processes involved in their development is one efficient strategy to integrate PBL in the classroom (Iji, Emiakwa & Utubaku, 2015). Therefore, giving students a trigonometry problem does not guarantee that they will be able to answer it. Nevertheless, the steps followed by the students to reach their conclusion correct or not-implied that the intended concepts and theories had been learned. One of the most well-liked curriculum improvements in education has been the use of problem-based learning. This is because the method is thought of as the model of multidisciplinary studies and helps students to have a clearer mind, and be adaptable to various ways of thinking (Johari, Nor Hasniza & Mokhtar, 2013). This study investigated the effect of the problem-based learning approach on Senior High School students' achievement in trigonometry.

1.1 Research Questions

The study sought to answer the following questions:

1) What difficulties do SHS students encounter in trigonometry in the Hohoe Municipality?.
2) What effect does problem-based learning have on SHS students' achievement in trigonometry in the Hohoe Municipality?
3) How do SHS students perceive the effectiveness of the problem-based learning approach in teaching and learning trigonometry in the Hohoe Municipality?.

1.2 Research Hypotheses

H_0: There is no significant difference between the mean scores of students in the experimental group and the mean scores of students in the Comparison group in the post-test

H_1: There is a significant difference between the mean score of students in the experimental group and the mean scores of students in the comparison group in the post-test.

2. RESEARCH METHOD

This study used both quantitative and qualitative data in a mixed-method approach. Mixed methods were used in the study's quasi-experimental (non-equivalent comparison group) design to gather data. To gather various, complementary data on the same subject for integration and interpretation to satisfy the study's overall content goal, a mixed-method approach was adopted (Creswell & Clark, 2017). For this research study, mixing quantitative and qualitative data was done to better comprehend the results and to use the advantages of both types of data (Cohen, Manion & Morrison, 2018; Creswell, 2013). On the other hand, this study also included the collection of qualitative data. With the help of interviews, the researchers were able to gain a thorough grasp of the SHS students' understanding of trigonometry during the teaching and learning processes as well as how the PBL approach stimulates them to learn from their points of view. The study's desire to modify the independent variable and examine its impact on the dependent (trigonometric achievement) variable justifies the use of a quasi experimental design. Additionally, the researchers provide intervention and gauge the effects it has (Cohen, Manion & Morrison, 2018)

2.1 Sample and Sampling Technique

The researchers selected two intact classes of ninety-four (94) students from the third-year classes as the sample from Hohoe SHS A and SHTS B. From this sample, forty-nine (49) students belonged to the experimental group in SHTS B, and forty-five (45) students belonged to the comparison group in Hohoe SHS A. A convenient sampling technique was used to select two Senior High Schools in Hohoe for the study. This sampling technique was used to select these two schools because of the researchers' easy access to both schools. Additionally, given the study's focus was on a topic from the mathematics curriculum, final year students were chosen using the purposive sample technique. The goal of this study was to improve their comprehension of the ideas and get them ready for their final exam. Again, purposive sampling was used to choose students from the experimental group who took part in the study's interview. This was based on the student's availability and willingness to engage in the study at the time of the interview (Creswell & Clark, 2017; Patton, 2015).

2.2 Research Instruments

Pre- and post-tests made up the trigonometry achievement test, questionnaire and semi-structured interview were used for data gathering. With the aid of the Core Mathematics curriculum objectives, these items were carefully chosen from Senior High School core mathematics textbook recommendations and previous exam questions (Ministry of Education, 2010). A 3-point Likert scale questionnaire with six (6) closed-ended questions were used to elicit responses from the students in the two groups. An open-ended semi-structured interview was used to get their input. According to McLeod (2014), the use of open-ended questions in semi-structured interviews has the advantage of assisting researchers in gathering qualitative data by enabling participants and the interviewer to have a thorough discussion. The purpose of the interview was to learn how students viewed PBL's efficiency in trigonometry teaching and learning. Additionally, to ascertain whether PBL activities had enhanced self-confidence, investigational skills, and topic comprehension, as well as whether they had boosted individual engagement in group activities and raised individual concentration.

2.3 Validity

The extent to which an instrument measures what it is designed to measure is considered the instrument's validity (Creswell, 2014). The Senior High School mathematics curriculum and certified textbooks by the Ghana Education Service were consulted in the test item creation to assure the validity of the Trigonometric Achievement Test. Past WAEC trigonometry exam questions were also taken into account. To assure their content validity, the experts in mathematics education cross-checked the questionnaire and subject questions in the interview guides and made adjustments as well as input.

2.4 Reliability

The researchers used a test-retest strategy to assess the reliability of the trigonometry achieve-ment test and questionnaire in this study. The test-retest method of determining reliability, according to Creswell (2012), entails giving the same test to the same individuals twice, separated by a significant amount of time. The test-retest dependability of the instruments increases with closer results. In this study, the researchers gave the trigonometry achievement test and the questionnaire to the pilot school's students, then gave them to the same students again a month later. The outcomes were used to change the instruments. The study's instruments were then adjusted and enhanced. Using SPSS, the correlation coefficient of test-retest reliability of the TAT and questionnaires between two sets of instrument responses was determined. The reliability of the trigonometry achievement test and the questionnaire had correlation coefficients of 0.82 and 0.89, respectively. Since both reliability values were more than 0.5, the two instruments were very dependable and might aid in answering the research questions.

2.5 Treatment

In this study, a quasi-experimental design was employed. To teach the experimental group trig-onometry, the researchers created models based on PBL instructions. Additionally, new lessons on the same trigonometry were developed to teach the comparison group using the conventional method. The lesson plans for the experimental and comparison groups both followed the precise objectives, content, teaching and learning activities and evaluation exercises for trigonometry in the Senior High School Core Mathematics curriculum in Ghana. Following the pre-test in January–March 2020, the treatment lasted for eight (8) weeks. Each group received two lessons throughout the initial week. There were 60 minutes in each lesson. To familiarize students with the methodology, the experimental group's first lesson consisted of introducing PBL and trigonometry to the class. As part of the teaching and learning activities carried out throughout the instructional sessions, the students were also put into smaller groups of five. According to the SHS Core Mathematics curriculum, the following lessons from the first to the eighth week were intended to help the students understand the fundamentals of trigonometry. The lessons covered the following topics: (1) Tangent, sine, and cosine of acute angles; and (2) trigonometric ratios of 300, 450, and 3600. (3) Using calculators to read the sine, cosine, and tangent of angles between 00 and 3600 (4) Reverse trigonometric ratios (5) Angles of elevation and depression (6) Using trigonometric ratios (Ministry of Education, 2010). The comparison group received orderly instruction using the usual teaching method from the researchers, while the experimental group received orderly instruction using the PBL methodology.

The lesson for the treatment of the experimental group was based on the Problem-Based Learning Cycle developed by Othman, Salleh, and Sulaiman (2013). The problem-based learning cycle involves meeting the problem; problem analysis; discovery and reporting; solution presentation, reflection, and evaluation. This problem-based learning cycle was chosen because it fosters student participation and teamwork in the creation of information, offers students a variety of possibilities for problem-solving, and helps students remember what they have learned. The comparison group was instructed to use the traditional approach, which emphasized the fluency of the procedure when resolving trigonometric problems. This class emphasized memorization of the steps needed to solve trigonometric problems. The researcher concluded by highlighting the pattern of procedures required in each question for students to recall after discussing sample questions, identifying solutions, and summarizing. The comparison group's students spoke with the researchers about their struggles with trigonometry during the educational time. The researchers made it easier for students to memorize the many steps of the concepts to address their issues. In addition, the PBL instruction was used to teach the comparison group to get a sense of the new approach and also use it in their West African Senior High School Certificate Exams since they were preparing for their final year exams.

3. RESULTS AND DISCUSSION

3.1 Research Question 1

What difficulties do SHS students encounter in trigonometry?

The results of the presentation was done in two ways. First, a descriptive analysis of pre-test scripts of all the 94 sampled students was done to identify difficulties faced by students in solving trigonometric problems. The second way was students' perception of trigonometric concepts and this was investigated through the administration of a closed-ended questionnaire to elicit students' responses from the options.

Based on the Table 1, on pre-test item 1, a closer look at each of the three difficulties under this category shows that 39 students out of the 94, constituting 41.5% of the sample for this study easily analyzed the diagram to form a right-angled triangle, whereas 36 had difficulty and could not, repre-senting 38.3% of the sample. In addition, 38 stu-dents out of the 94, constituting 40.5% of the sample for this study could easily use the basic trigonometry equation, whereas 37 students had difficulty and were not able to use the basic trigonometric equation, representing 39.4% of the sample. Concerning correct answers, through the use of correct algebraic calculation, 27 students out of the 94 constituting 28.7% were able to get the final answer. Forty-eight representing 51.1% of the sample could not get the correct answer and 19 out of 94 representing 20.2% were not able to attempt item 1 at all. On pre-test item 3, students had difficulty applying trigonometric concepts to real-life problems and solving them. In all, 3 students, constituting 3.2% of the sample for this study were able to solve the real-life problem in trigonometry, whereas 57 students out of 94, representing 60.6% had difficulty and could not solve the real-life problem completely. A total of 34 students out of 94, representing 36.2% could not even attempt the task.

Based on these results, it was clear that students had difficulties understanding trigonometric diagrams to make meaningful analyses for them to employ the appropriate algebraic calculation to solve the task. Also, the majority of students memorized the procedures due to a lack of understanding and not solving enough problems on the topic. This made it difficult for them to solve real-life trigonometric problems. Hence, they ended up having difficulties solving trigonometric problems by committing basic arithmetic errors and use of inappropriate procedures.

Table 1. Students' difficulties in the Pre-test

Item	Difficulties	Correct (f %)	Incorrect (f %)	No attempt (f %)
1.	Difficulty in analyzing the diagram to form a right-angled triangle	39(41.5)	36(38.3)	19(20.2)
	Difficulty in using basic trigonometric equation	38(40.5)	37(39.4)	19(20.2)
	Difficulty in performing the correct algebraic calculation	27(28.7)	48(51.1)	19(20.2)
2.	Difficulty in understanding trigonometric information to sketch the required diagram	33(35.1)	37(39.4)	24(25.5)
	Difficulty in performing the correct algebraic calculation	9(9.6)	61(64.9)	24(25.5)
3	Difficulty in applying trigonometry to real-life problems	3(3.2)	57(60.6)	34(36.2)

Table 2. Students' perception of trigonometric concepts

Students' perception of trigonometric concepts	Agree (f %)	Disagree (f %)	Undecided (f %)
The teacher used step-by-step presentations to teach trigonometry concepts for I to understand	9(9.6)	72(76.6)	13(13.8)
Terms in trigonometric topics difficult to understand	78(83.0)	11(11.7)	5(5.3)
Trigonometry involves memorization of formulae without understanding	64(68.1)	22(23.4)	8(8.5)
I have a challenge in learning trigonometry because the concepts are abstract	53(56.4)	35(37.2)	6(6.4)
Lack of self-confidence to learn and solve trigonometric problems	69(73.4)	19(20.2)	6(6.4)
Real-life trigonometric problems are difficult to understand	81(86.2)	10(10.6)	3(3.2)

Table 2 shows that 9 students, constituting 9.6% of the sample for this study agreed that teacher used step-by-step presentation for them to understand the trigonometric concepts, whereas 72 disagreed, representing 76.6% of the sample and 13 were undecided, representing 13.8% of the sample. In addition, 78 students, constituting 83% of the sample for this study agreed that terminologies in trigonometric topics were difficult to understand, whereas 11 disagreed, representing 11.7% of the sample, and 5 students were undecided, representing 5.3% of the sample. Furthermore, 64 students, constituting 68.1% of the sample agreed that trigonometry involves memorization of formulae without understanding, whereas 22 disagreed on this, representing 23.4% of the sample, and 8 were undecided, representing 8.5% of the sample. Also, 53 students agreed that they have a challenge in learning trigonometry because the concepts are abstract, constituting 56.4% of the sample, whereas 35 representing 37.2% of the sample disagreed and 6 were undecided, representing 6.4% of the sample. On the issue of lack of self-confidence to learn and solve trigonometric problems, 69 students constituting 73.4% of the sample agreed on it, whereas 19 disagreed, representing 20.2% of the sample and 6 representing 6.4% of the sample were undecided. Finally, the real-life trigonometric problems are difficult to understand, 81 students agreed, con-stituting 86.2%, whereas 10 disagreed, representing 10.6% of the sample and 3 representing 3.2% of the sample were undecided.

Based on the results, a lot of students believed that their mathematics teachers did not use the appropriate steps during instructional processes to help them understand trigonometric concepts. It was also revealed by the results that the trigonometric topic was difficult to understand due to its abstractness and therefore, students just memorize the formulae without understanding. Finally, these results confirmed the difficulties they had in solving real-life problems in trigonometry which the basic cause was a lack of understanding of trigonometric concepts as shown in **Table 2**.

3.2 Research Question 2

What effect does problem-based learning have on SHS students' achievement in trigonometry in the Hohoe Municipality?

The findings from the semi-structured interview with five students who were arbitrarily chosen from the experimental group are presented in this section. These codes were provided to students to protect their identities throughout the interview: S1, S2, S3, S4, and S5. The themes from the interview guide were used to help in the transcription and analysis of the interview material. The following is a presentation of the interview data:

Question: What is your view about trigonometry as a topic in the mathematics syllabus when it was first taught?.
This was the response from S1:

> *"Trigonometry is a difficult topic and I do not like it at all. I did not understand the concepts because the mathematics teacher rushed through the trigonometry claiming that we have been taught Geometry in the previous lesson which serves as a foundation and this makes the topic difficult for me to understand."*

When S2 was asked the same question, S2 said:

> *"With regards to trigonometry, when the teacher came to class, he only talked about the concepts without involving us, put examples on the board, and solved them for us. So, I found it difficult to learn and understand the topic.*

S5 in response to the same question said:

> *"I used to have the feeling that trigonometry is difficult but now l have a change of mind because of the current understanding I have about it."*

Question: How is your overall experience learning trigonometry now?
This was the answer given by S3:

> *"At first, it was not easy learning and solving trigonometric problems. But now the current trigonometry learning activities are my best experiences ever because the teacher uses good instructional strategies to help us concentrate and enjoy the learning period. This helps me to develop a better understanding of trigonometry."*

Responding to the same question, S4 remarked:

> *"The trigonometric activities are very interesting. I learn from those activities which encourage me to think and analyze the problems before I start to solve them. Now, I can say that my understanding has improved."*

S2 in response to the same question said:

> *"I now understand the trigonometric concepts. Therefore, my performance will be good in it."*

Question: Do you feel the new instructional strategy is useful in teaching and learning trigonometry? Why?
S1 in response to this question said:

> *"Yes! This new strategy allows us to share ideas in groups and come out with our solutions. This helps us to be involved in the instructional process."*

In response to the same question, S3 responded:

> *"Yes! The group discussion and presentation in the class helps us to have the self-confidence to learn and understand the topic."*

S4 responded to the same question:

> *"Yes, group discussion and presentation, and searching for information concerning the topic make all of us partake in the learning process."*

Question: What difference did the PBL approach make in your learning process of trigonometry as compared to your teachers' method?
In answering this question, S3 remarked:

> *"When I was involved in doing something, it was easy to remember as compared to you telling me how to do it. Therefore, being part of PBL activities helped me to have a better understanding than just listening to the concepts which used to be the case."*

S5 in response to this same question said:

> *"PBL is practical therefore, all of us are involved in the teaching and learning process."*

Responding to the same question, S1 said:

> *"It improved my understanding of the trigonometric concepts more than the previous method."*

Question: What are the teaching and learning activities used to learn trigonometry through PBL that you like? Why?
Response from S1:

> *"Group discussion, collaborative work, and presentation. They help to promote communication skills and self-confidence in me."*

In answering the same question, S2 said:

> *"The search for information to answer the questions through group activities and sharing of ideas promote understanding and mastery of the topic."*

Question: Would you prefer that the PBL approach be used by mathematics teachers for every mathematics topic? Why?
S6 nodded his head and said:

> *"Yes! If this approach is used for all mathematics topics, it will be of great help for us to understand all the topics."*

This was the response of S2:

> *"Yes! This will encourage me to be involved in all teaching and learning processes of every topic and it promotes smooth learning."*

According to their comments, the students thought trigonometry was a challenging subject. The majority of the students believed that this was a result of the instructional strategies employed by the mathematics teachers while teaching and mastering the topics. Additionally, they stated their happiness that the PBL approach, which combines learning through discussion and group activities, kills boredom. Additionally, students felt that group projects, investigations, and presentations were successful in fostering communication skills, concept mastery, and increased self-confidence among them. Students also advised that the PBL methodology be used for the remaining mathematics topics. This will encourage students to study mathematics and gain a deeper understanding of it.

3.3 Research Question 3

How do SHS students perceive the effectiveness of the problem-based learning approach in teaching and learning trigonometry in the Hohoe Municipality?. This section presents the results of the Trigonometric Achievement Test (TAT) administered to the students within the period of carrying out this study. The results from both the pre-test and post-test are presented in **Table 3.**

Pre-test scores of comparisson and experimental groups

The pre-test scores of experimental and control groups were analyzed and compared to determine if there existed any significant difference in the scores before treatment. **Table 3** shows the mean, standard deviation, maximum, and minimum of the pre-test scores between the two groups.

Table 3. Descriptive statistics of pre-test scores of comparison and experimental groups

Group	N	Mean	Std Dev	Maximum	Minimum
Comparison	45	4.67	4.6	19	00
Experimental	49	4.10	4.8	15	00

Based on the **Table 3**, the results illustrate a mean score of 4.67 for the control group and 4.10 for the experimental group. The minimum scores of the control and experimental were 00. Furthermore, the comparison and experimental groups scored maximum marks of 19 and 15 respectively. Looking at the mean scores of the groups would suggest that the control group performed better (mean = 4.67) than the experimental (4.10). To verify whether the difference in mean scores between the two groups was statistically significant, an independent sample t-test was performed at a 95% confidence interval. This result was shown in **Table 4**.

Table 4. Independent sample t-test of pre-test scores of comparisson and experimental groups

Group	N	Mean	Std Dev.	T-value	Df	P- value
Comparison	45	4.67	4.6	0.585	92	0.560
Experimental	49	4.10	4.8			

Based on the **Table 4**, the result from the independent sample t-test performed on the pre-test scores of the two independent groups revealed that there was no statistically significant difference between the control group (M = 4.67, Std D = 4.6) and experimental group (M =4.10, Std D = 4.8) conditions; t (92) = 0.585, P = 0.560 > 0.05. This result suggests that both control and experimental groups were at the same level in terms of conceptual understanding of trigonometry before intervention was done.

Post-test scores for comparisson and experimental groups

Treatment was done for each group and a post-test was administered to measure participants' level of change in achievement compared to the pre-test. This part presents the results from the post-test scores for both groups.

Table 5. Descriptive statistics of post-test scores of comparisson and experimental groups

Group	N	Mean	Std. Dev.	Maximum	Minimum
Comparison	45	10.71	8.5	30	2
Experimental	49	15.84	7.7	30	4

Based on the **Table 5**, the results illustrate a mean score of 10.71 for the control group and 15.84 for the experimental group. The minimum score of the control and experimental groups were 02 and 04 respectively. Also, both groups scored a maximum mark of 30. Comparing the mean scores of the comparison group from Table 4.4 (Mean = 4.67) and Table 4.6 (Mean = 10.71), and an experimental group from Table 4.4 (Mean = 4.10) to Table 4.6 (Mean = 15.84) suggested that participants in both groups improved in their performance in the post-test. This is evidence that the performance of participants in the groups improved after treatment. To establish whether the difference in the pre-test and post-test scores within each group was statistically significant, paired sample t-test was conducted to compare the pre-test and post-test scores. The results are shown in **Table 6**.

Table 6. Paired sample t-test scores on the post-test and pre-test

Group	N	Mean	Mean Diff	Std. Dev.	t-value	Df	p-value
Comparison							
Pre-test – Post-test	45	4.67 10.71	6.04	7.3	5.54	44	0.000
Experimental							
Pre-test- Post-test	49	4.10 15.84	11.74	6.6	12.49	48	0.000

The analysis presented in **Table 6** shows that within the comparison group there was an increase in students' achievement scores in trigonometry from pre-test to post-test, conditions; t (44) = 5.54, p = 0.000< 0.05. This increase indicates that to some extent the traditional method and teacher influence increased students' achievement in trigonometry concepts. Also, the pre-test and post-test scores for the experimental group show a great improvement in students' performance in the trigonometric concepts after they have been exposed to the PBL approach, conditions; t (48) = 12.49, p = 0.000 < 0.05. Thus, the activities of the PBL approach have increased students' performance and conceptual understanding of the topic greatly. This research question focuses on the effectiveness of a problem-based learning approach in the n acquisition of trigonometric concepts compared to traditional instruction on students' achievement. In answering this research question, the following hypothesis was used for the study:

H_0: There is no significant difference between the mean score of students exposed to PBL and the mean score of students without PBL.

H_1: There is a significant difference between the mean score of students exposed to PBL and the mean score of students without PBL.

However, to ascertain the significance of this effect and change, the researcher conducted independent samples t-test on the post-test scores of both the control and experimental groups. Table 7 illustrates analysis from the results of the independent sample t-test.

Table 7. Independent sample t-test of post-test scores of the experimental and comparison groups

Groups	N	Mean	Std Dev	t-value	Df	P-value	Eta squared
Comparison	45	10.71	8.5	3.06	92	0.003	0.144
Experimental	49	15.84	7.7				

Based on the results presented on the **Table 7** the independent sample t-test revealed that there was statistically significant difference between the comparison group (M= 10.71, SD= 8.5) and experimental group (M= 15.84, SD= 7.7) conditions; t (92) = 3.06, p = 0.003 < 0.05. This is an indication that the experimental group which was exposed to the PBL approach during the teaching and learning of trigonometry concepts outperformed the comparison group. The eta squared of 0.144 showed a large effect size which indicated that 14.4% of the variance in the post-test scores of the TAT (dependent variable) is influenced by the instructional approach (independent variable). Based on Cohen's rules of thumb on the magnitude of eta-squared interpretation done by Miles and Shelvin (2001), an eta-squared value of 0.01 (1%) has a small effect size, eta-squared values of 0.06 (6%) have medium effect size and eta squared 0.14 (14%) has large effect size. This result showed that the difference between the mean score achievement on the post-test of the students that experienced the PBL approach and those who experienced the traditional approach was large. Therefore, the use of the PBL approach in trigonometry produced a significant improvement in students against the traditional approach.

Three challenges prevented students from successfully resolving the problems. Therefore, it is difficult to analyze the diagram to create a right-angled triangle, difficult to use basic trigonometric equations, and difficult to perform the necessary algebraic calculations to get the solution. Due to their lack of knowledge, some students were unable to even attempt the question. The findings of this study support the general results found in the related literature by (Aminudim, Nusantara, Parta, Rahardjo & Subanji, 2019; Gur, 2009; Rohimah & Prabawanto, 2019; Tatlah, Amin &Anwar, 2017; Usman & Hussani, 2017). In their studies, these researchers found that students struggled to recall both their previous and new understanding of trigonometric concepts, which made it difficult for them to solve trigonometric problems and left them lacking in procedural abilities. Additionally, because they struggle with basic trigonometric equations, students wind up remembering the concept and technique without understanding it. According to the results, several students struggled to comprehend trigonometric concepts to draw the required diagram and instead drew unnecessary ones. Additionally, students encountered difficulties while applying the proper techniques to the problems. All of these resulted from a misunderstanding of terminology and incorrect definitions brought on by memorizing the steps or a process for solving trigonometric problems. These conclusions are strongly supported by past research studies (Gur, 2009) which discovered that definition, conceptual misunderstanding, and technical mechanical faults were to blame for pupils' struggles with trigonometry problems in different research. When students were attempting to solve mathematical problems, these caused incorrect use of equations and order of operations.

The findings showed that practically every student had trouble comprehending and resolving problems in real-life situations. This problem resulted from students' inability to complete enough math problems to better understand the concepts and math teachers' inability to connect trigonometric concepts to practical applications so that students would be familiar with them. This result is consistent with earlier research (Charles-Ogan & George, 2015; Numedina & Rafidaya, 2019), which identified some factors, including a lack of problem-solving skills in mathematics and a lack of familiarity with real-world trigonometric questions, as contributing to students' struggles with trigonometric problems. The respondents also concurred that learning trigonometry was difficult since the concepts were abstract and that it required memorizing formulae without understanding. The results of this study's responses are in line with those of a study done by Nabie, Akayuure, Ibrahim-Bariham, and Sofo (2018) on pre-service teachers' perceptions and knowledge of trigonometric concepts in two colleges of education in the Northern Region of Ghana. In that study, it was discovered that pre-service teachers thought the trigonometric concepts were abstract and so they memorized them without understanding when learning. Finally, students believed that understanding real-world trigonometric problems were challenging and that they lacked the confidence to grasp and solve trigonometric problems. This showed that students lacked confidence in their ability to learn about and solve problems with trigonometry since they did not understand the concepts. Students also struggled to comprehend the material they needed to learn to answer the issues, and their lack of familiarity with real-world trigonometric activities also contributed to the difficulties they faced with trigonometry. The results of this study are consistent with those of earlier studies (Aminudin, Nasantara, Parta, Rahardjo, Asari & Subanji, 2019; Nurmeidina & Rafidayah, 2019), which discovered that students lack skepticism toward mathematical problems, they struggle to comprehend the problem required to complete the tasks, and they are unfamiliar with real-life trigonometric problems. As a result, when learning trigonometric concepts, students become perplexed.

Trigonometry is one of the more challenging subjects at the SHS level, according to the replies provided by the participants in the interview, which are listed under the presentation of the results. The abstract nature of the problem and the instructional strategy used by the mathematics teachers to teach and learn the material, in the students' eyes, was to blame for this. Again, based on their answers to the interview questions, it was clear from the results that the experimental group of students was driven to learn trigonometry and comprehend the concepts. They believed that the PBL method of teaching and learning offered an environment where they could work in groups to discuss ideas, conduct research, and come up with answers. This sparked students' interest in the subject, helped them understand the material and helped them develop their confidence as learners. As a result, they developed into independent problem-solvers, self-directed learners, and critical thinkers in the classroom, and they suggested the PBL technique be utilized for additional mathematical disciplines. The findings of this study supported those of numerous other studies (Kaharuddin, 2018; Lozinki, Poon & Spaco, 2017; Mushlihuddin, Nurafifa & Irvan, 2018; Olaoye & Adu, 2015; Tandililing, 2015), all of which found that the PBL approach to mathematics encourages group participation, active learning, and conceptual understanding of the concepts.

The results of the independent samples t-test revealed that, before treatment, there was no statistically significant difference between the achievement levels of participants in comparison groups in their acquisition of trigonometric concepts. This demonstrated that before treatment began, both groups had mastered the same degree of trigonometric concepts. Results from the paired samples t-test of the scores of the comparison and experimental groups revealed that experimental group members who were exposed to the PBL strategy improved more from the pre-test to the post-test than the comparison group. Additionally, the results of the independent samples t-test revealed a significant difference in the post-test performance between individuals who had been exposed to the PBL technique and those who had been exposed to the traditional strategy in the comparison group. The fact that the two groups' achievement levels were different suggested that the experimental group outperformed the comparison group on the post-test. The outcome created an eta squared of 0.144 (14.4%), a considerable effect. This showed that there was a significant difference in the mean achievement scores between the students who used the PBL strategy and those who used the traditional strategy on the post-test. In comparison to the traditional approach, using the PBL approach in trigonometry results in a considerable improvement in student performance. Due to the usage of PBL during the treatment period, trigonometry performance and achievement improved. This result is in line with that of (Abdullah, Tarmizi & Abu, 2010; Bukari & Asiedu-Addo, 2019; Iji, Emiakwu & Utubaku, 2015; Olaoye & Adu, 2015), who discovered that PBL enhanced students' learning, conceptual comprehension, and accomplishment in mathematics.

4. CONCLUSION

The results of this paper showed that teachers dominated classroom interaction activities during teaching and learning trigonometry at Senior High Schools. This gave students limited opportunities to take an active part in the lesson such as sharing ideas on the concepts among themselves. Mathematics teachers gave much information to the students to absorb without much contribution from the students which did not encourage conceptual understanding. Mathematics teachers should have allowed students to do much of the work during teaching and learning trigonometric concepts for a better understanding of the topic. Finally, the major contribution of this study was the knowledge about the effect of the problem-based learning approach on SHS students' achievement in trigonometry. In this study, the experimental group was given instruction based on the PBL approach while the control group was instructed by the traditional approach. Students in both groups showed increments in their post-test results of TAT as compared to pre-test results. However, students in the experimental group achieved a better understanding of the trigonometric concepts than that in the control group. It can be stated that PBL instruction of trigonometric concepts had a positive effect on SHS students' achievement. The involvement of the students in the lessons by PBL led to the understanding of the concepts and therefore, improved students' performance in the post-test.

AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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Research Article

The process of achieving the principles of the triangle area of middle school students through Youtube assisted learning during a pandemic

Rahmat Jumri[1], Wahyu Widada[2✉], Dewi Herawaty[2]

[1] Department of Mathematics Education, Universitas Muhammadiyah Bengkulu, Bengkulu, Indonesia
[2] Postgraduate Program of Mathematics Education, Bengkulu University, Bengkulu, Indonesia
✉Corresponding Author: wahyu.unib@gmail.com

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ABSTRACT

The purpose of this study was to described the achievement of the triangular principles of junior high school students through YouTube-assisted learning during the COVID-19 pandemic. It is exploratory research. The subjects of this study were elementary school students in Bengkulu City, Indonesia. We conducted task-based interviews with twenty-one people. The data from the completion of the task was analyzed early to determine their level of thinking. It was using its genetic decomposition. We classified them into five levels of schema development. We selected students who were at the trance level for further in-depth interviews. We use audio-visual recorders to get complete and accurate data. Data were analyzed by applying qualitative data analysis techniques. The results of this study were 19% of the research subjects were at the intra level, 33% were at the semi-inter level, 33% were at the inter level, and 10% of the subjects were at the inter level, and only one person who was at the trance level (= 5%). The conclusion of this study is that students who are at the highest level are able to build relationships between actions, processes, objects, and previous schemas so that a mature schema is formed about the area of the triangle.

Keywords: area of triangle; youtube; rectangle: covid-19; middle school students

1. INTRODUCTION

There is currently a COVID-19 pandemic that has lasted almost a year. This pandemic has greatly affected the learning process in schools. During this pandemic all schools are closed. According to (Mailizar, Almanthari, Maulina, & Bruce, 2020) that school closures in Indonesia during the COVID-19 pandemic have left 45.5 million school students and 3.1 million teachers dependent on online teaching and learning. Online teaching and learning are an unprecedented experience for most teachers and students; consequently, they have limited experience with it. The results showed that student-level barriers had the highest impact on the use of e-learning. In addition, student-level barriers show a strong positive correlation with school-level barriers and curriculum-level barriers. The study showed that the teacher's background had no impact on the level of inhibition. This study stimulates further discussion on how to overcome barriers to e-learning while maximizing the benefits of E-learning during this pandemic and beyond by highlighting the importance of student voices. (Mailizar et al., 2020). The COVID-19 pandemic has had an impact on the world of education. Learning strategies change rapidly from face-to-face learning to online learning. Research result (Kusumaningrum & Wijayanto, 2020), It was found that online lectures are often constrained by the internet network which is difficult to reach. Online learning activities are not running smoothly. As a result, students cannot understand the material well. Students want online learning videos and discussions conducted through the WhatsApp or Google Classroom application.

Technological advances also touch the world of education where learning technology becomes more effective and efficient. Therefore, the term e-learning is an electronic-based learning model that is supported by various kinds of hardware, software and various advanced features that can be used by teachers in the learning process. One of the media that can be continuously and at any time used in learning is through YouTube. This media makes it easy for math teachers to interact with students or other YouTube users. According to Horstman, educators need an adequate level of technological knowledge to be able to confidently combine various forms of technology through YouTube channel (Nugroho, Widada, & Herawaty, 2019). Thus, this paper describes students' cognitive processes in understanding the triangle principle and determining alternative syntax for learning mathematics during the COVID-19 pandemic with the help of YouTube. A triangle is a geometric figure which is a combination of three-line segments that meet at the ends. This concept is often difficult for students to understand (Widada, Herawaty, Hudiria, Prakoso, et al., 2020; Jumri & Murdiana, 2019; Widada, Herawaty, Jumri, Zulfadli, & Damara, 2019). In learning it through the YouTube channel, it makes it easier for students to learn at any time. Students can learn mathematics through the development of their cognitive processes anytime and anywhere in arithmetic-algebra, measurement-geometry and probability-statistics sequences (Lehmann, 2018). Measurement-geometry is a difficult subject for students to learn (Widada, Herawaty, Jumri, & Wulandari, 2020). One of the most difficult principles for elementary school students is finding the area of the triangle. Students often experience dis-equilibration about the concepts and principles of triangles. The imbalance occurs as a result of the exposure of the triangle image and its real form which is seen from several components that do not produce a single triangle scheme (Sarama & Clements, 2016). Therefore, sequential reasoning is needed. The reasoning is used to describe and rearrange each successive form that arises from the previous form. It was reasoning to reinvent the method for decomposing and rearranging a trapezium (parallelogram-triangle-rhombus-kite-trapezium) (Lehmann, 2018).

In Geometry learning, content is studied about fields, as well as solid shapes and their properties. A plane shape is a geometric object with length, width and height. It is a 2D (2-Dimensional) shape. These shapes are squares, rectangles, circles, polygons, triangles, and other flat shapes (T.R., 2017). Geometry is an important branch of mathematics. The surroundings we see and use are geometric shapes. These geometric objects can be used as a basis for thinking to achieve geometric concepts [9]. Therefore, the use of resources from the environment, local content and various cultural forms can be used as starting points in learning geometry (Sunzuma & Maharaj, 2019; Widada, Agustina, Serlis, Dinata, & Hasari, 2019; Ma'Rifah, Widada, Aida, Yulfitri, & Effendi, 2019; Widada, Herawaty, Andriyani, Marantika, & Yanti, 2020; Herawaty, Khrisnawati, Widada, & Mundana, 2020). For example, ethnomathematics is applied to the classroom as a mathematical activity in a cultural context (Lipka & Andrew-Irhke, 2009).

Mathematics learning needs to accommodate continuous and ongoing changes in student culture and school mathematics subjects (Rosa & Orey, 2011). Today, modern mathematics is emerging as a diverse cultural group trying to solve real-world problems (Orey & Rosa, 2004)(Jumri & Murdiana, 2022). Mathematics culture and education are closely related (Widada, Herawaty, Jumri, Wulandari, et al., 2020)(Widada, Herawaty, Lusiana, Afriani, et al., 2020)(Jumri & Murdiana, 2022). Mathematics education can be more effective if the starting point is from a particular cultural context. It was to explore the relationship between the thought processes of cultural groups, and mathematics education (Barton, 1996). On the other hand, Geometry is one of the compulsory subjects for students. It is having an abstract object, by utilizing primitive elements (i.e. points, lines, and fields)(Widada, Herawaty, Hudiria, Prakoso, et al., 2020). The triangle is a concept. It is a geometric object that is limited by a sense. Triangle as a geometric figure consisting of three-line segments that meet at the ends. The restricted area has an area. Therefore, students are asked to be able to find the area. Area is one of the measurement domains about area. The area of a composite shape can be calculated by breaking it down into simpler forms. That is to use the area of each of the simpler shapes and add them up to find the total area (Lehmann, 2018). Therefore, to determine the area of a triangle can be determined by adding up the area of the unit square. It is the area that covers the entire area of the triangle. Thus, we want to describe how students determine the area of a triangle using simple media. Students can be described through their genetic decomposition. It is an activity based on the action-process-object-schema. Thus, this paper discusses the process of achieving the principle of the area of a triangle after learning with the help of YouTube.

2. RESEARCH METHOD

This type of research is development research with qualitative methods through applying task-based interviews (Widada, Herawaty, Lusiana, Afriani, et al., 2020a). The research subjects were given the same task in the form of problems about the concept and principle of the triangle. The subject of this research will be taken purposively from elementary school students in Bengkulu City who have received lessons on the concept and principle of triangles. The selection of research subjects was carried out in stages according to needs. The results of direct interviews were analyzed so that the characteristics of students in achieving the principle of the area of a triangle could be determined. The main instrument in this research is the researcher himself, guided by several guide sheets. The guide sheets are student assignment sheets and interview guide sheets. The student assignment sheet contains problems about the principle of the triangle.

Subjects are given questions about triangles to solve. Subjects were given the opportunity to complete the task and were then immediately interviewed with interview questions according to their completion. The research data were analyzed, namely the analysis of genetic decomposition of the abstraction process carried out by the subject (Widada, Herawaty, Hudiria, Prakoso, et al., 2020; Widada, Herawaty, Lusiana, Afriani, et al., 2020b). Genetic decomposition is a structured collection of mental activities carried out by a person to describe how mathematical concepts/principles can be developed in his mind (Widada, Herawati, Fata, Nurhasanah, et al., 2020). The genetic decomposition that will be analyzed in this study is more specifically on the mental and physical activities of the subject related to the process of achieving concepts or principles. The results of this analysis will be used to determine the characterization of the research subject.

3. RESULTS AND DISCUSSION

Learning geometry in a system provides its own challenges for students. When faced with learning Euclidean geometry for flat planes, students still have a fairly good understanding, but when they start studying non-Euclidean geometry, they begin to have difficulty understanding it. During the COVID-19 pandemic, students are taught online. In this study, learning geometry, especially learning triangles, uses the help of YouTube with the link: **https://www.YouTube.com/watch?v=ebpdE0Uvub0**

Based on the data on the results of student work through paper-and-pencil from 21 students, the classification of students' abilities in finding the area of a triangle was obtained. Research subjects are given the freedom to find the area of the triangle. The analysis of the student's paper-and-pencil results can be presented in a pie chart as can see in **Figure 1.**

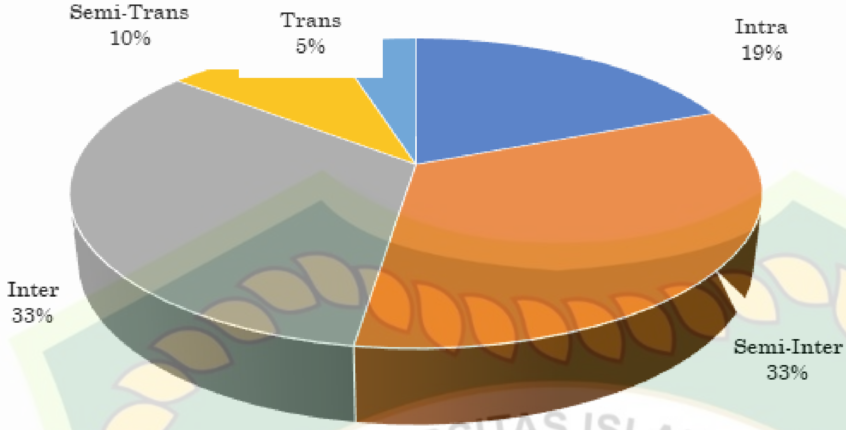

Figure 1. Subject percentage data based on the level of triad+

Figure 1 shows that 19% of the research subjects were at the intra level, 33% were at the semi-inter level, 33% were at the inter level, and 10% were at the inter level (2 people) subjects were at the inter level, and only one person was at the trance level (= 5%). These results indicate that students who are at the highest level tend to be less (Wahyu Widada, Herawaty, Jumri, Wulandari, et al., 2020). It was a student who had good cognitive abilities. Based on this classification, we are interested in exploring research subjects who are at the trance level (only 1 subject, namely Ps). Based on the assignment given to the research subject, it was found that students found the area of a right triangle. He found through the area of the rectangle. Subject Ps recalled the formula for the area of a rectangle. Look at **Figures 2** and **Figure 3.**

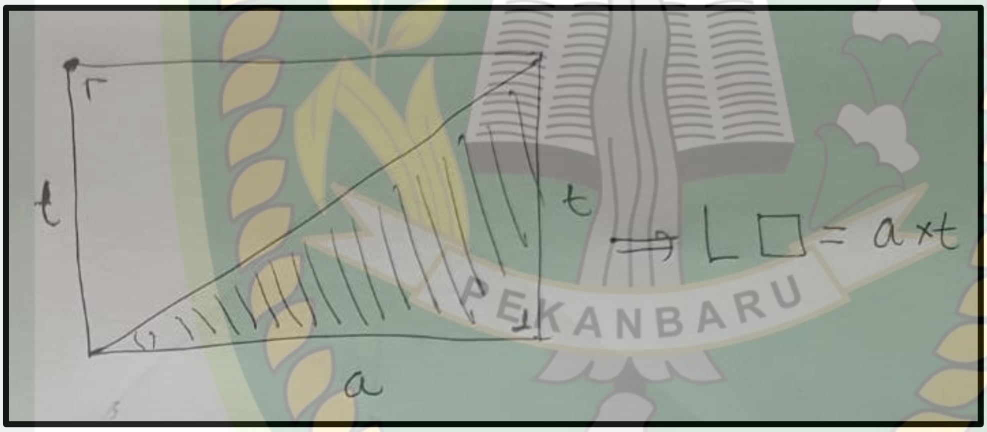

Figure 2. Subject PS remembers the area of the rectangle

Based on paper-and-pencil as shown in **Figure 2**, Researcher (R) conducted an interview with Ps. Excerpts from the interview are as follows.

R : How do you get the area of a triangle?
PS : I tried from the area of the rectangle. I remember that the area of a rectangle is the length times the width.
R : Okay…
Ps : Look at the picture of a rectangle (**Figure 2**),….for example, the length is a and the width is t, then the area of the rectangle is a x t.
R : Ok continue…
PS : You can see the picture again, … the shaded area is the area of a right triangle…. Its area is equal to the area of the unshaded upper triangle...
R : Alright….
PS : That means that the area of the rectangle is equal to twice the area of the right triangle…
R : ……
PS : I can conclude that the area of the right triangle is equal to half the area of the rectangle. So, the area of the triangle is equal to (½a x t) …. You can see it in **Figure 3**.

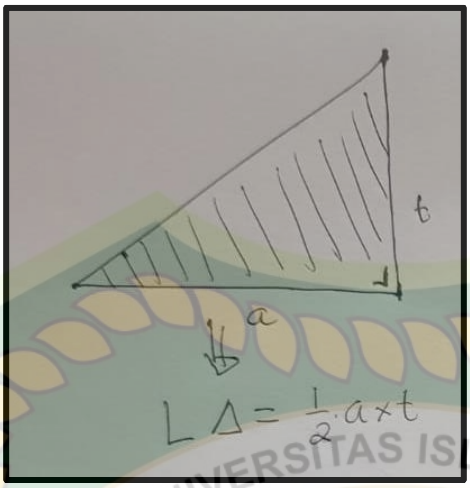

Figure 3. Area of triangle = ½ (a x t)

Based on the interview excerpts, **Figures 2** and **Figure 3**, it shows that Ps is able to find the area of a right triangle through drawing actions and the process of recalling the area of a rectangle. Ps makes use of the rectangular area a x t. It is an encapsulation of a rectangular object and using a rectangular diagonal scheme divides the rectangle into two equal parts. Those are two right triangles. Ps is able to achieve a new scheme where the area of the triangle is of the area of the rectangle (See Figure 3). Next, Ps finds the area of a triangle through an acute triangle (See **Figure 4**).

Figure 4. PS finds the area through the acute triangle

Based on the description and **Figure 4**, Ps is able to build links between actions, processes, objects, and previous schemas so that a mature schema is formed. This is in accordance with previous research found that there are students who carry out the process of encapsulating the properties of functions or intervals in the domain so that objects are formed (W. Widada, Herawaty, Nugroho, & Anggoro, 2019), and for the context of the properties of real numbers (Herawaty, Widada, Herdian, & Nugroho, 2020). That is the beginning to reach a mature scheme (Wahyu Widada, Herawaty, Nugroho, & Anggoro, 2019). When we refer to several models of student cognition, there is a sequence of proving the area of a triangle that is expected to increase their level of thinking. It is a sequence by utilizing a simple medium as follows. Look at **Figure 5.**

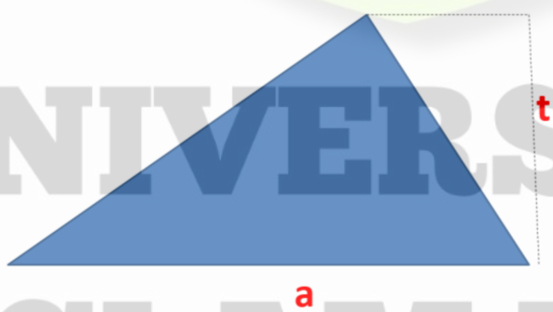

Figure 5. A triangle with base a and height t

Based on **Figure 5**, cut the triangle parallel to the base with height t. Draw a high line through the top and cut the base. That is forming one trapezoid and two triangles (ie red and yellow). Look at **Figure 6.**

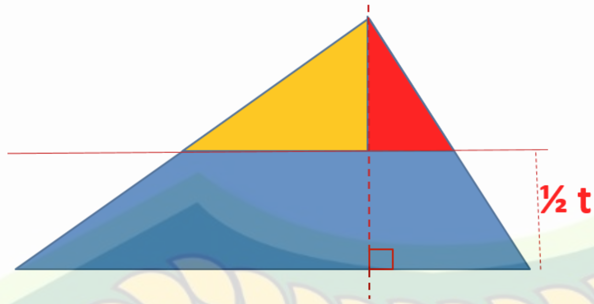

Figure 6. The triangle is divided into 3 other shapes

Based on **Figure 6**, we separate into 2 triangles and 1 trapezoid. It looks like **Figure 7**. The three shapes each have a height of t.

Figure 7. Two triangles and one trapezium

Two triangles and one trapezium as can be seen in **Figure 7**, then a new shape is formed. This is done via the blue arrow. The yellow triangle rotates, as does the red triangle. The newly formed building can be seen in **Figure 8**.

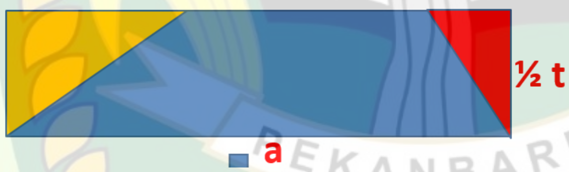

Figure 8. Rectangle is a new shape formed

Based on **Figure 8**, the new shape formed is a rectangle. It is a shape that has length a and width t. Students are able to remember that the area is (a x ½ t) = ½ (a x t). The rectangle is having the same area as the triangle that made it up. Thus, the area of the triangle = the area of the rectangle formed from the triangle = ½ (a x t). Therefore, students return to their original shape, namely a triangle (See **Figure 9**).

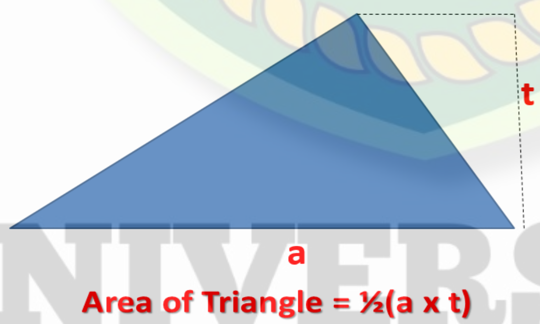

Figure 9. Area of a triangle

Based on the steps in **Figure 8** and **Figure 9**, students are able to conclude that the area of a triangle whose base is a and the height is t is ½ (a x t). It is a strategy of discovering the principle of the triangle through simple media. This strategy can also be seen through online media. We can see this process through YouTube media shows with the link: **https://www.YouTube.com/watch?v=wW0Vm3h3beA&t=3s**. Therefore, the right learning strategy can make it easier for students to do cognitive activities well (Widada, Herawaty, Widiarti, Aisyah, & Tuzzahra, 2020) (Widada, Herawaty, Hudiria, Prakoso, et al., 2020)(Widada, Herawaty, Widiarti, Aisyah, et al., 2020).. This can be done through a more contextual approach, also utilizing media that are close to the minds and culture of students (Widada, Herawaty, Pusvita, Anggreni, et al., 2020). Thus, simple learning media are able to trigger students to carry out action-process-object activities in such a way as to achieve a scheme about the triangular principle. Also, it can be extended to other mathematical concepts and principles.

4. CONCLUSION

The results of the study concluded about the geometric activity in "Rumah Tuo". These activities are calculating, measuring, and designing the Rumah Tuo of the Rantau Panjang Batin as a mathematization process through an ethnomathematical approach. Counting activities are found in traditional objects, namely Gantang Biheh to calculate rice yields and the amount of zakat issued and fines from traditional sanctions of one hundred. That means that all things must be sanctioned as much as one hundred, such as one hundred bushels of rice, one hundred kilos of meat, and one hundred kajang cloth. The measuring activity is found in the house pole which was built based on the number of people who lived at the beginning in the Rumah Tuo, and the designing activity is in the form of the house that was built designed in the form of an ancient means of transportation, namely a ship.

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AUTHOR’S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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Research Article

Students creative thinking skills on differentiated instruction

Peni Anggareni[1], Akhmad Faisal Hidayat[2]

[1] Department of Mathematics Education, Universitas Pendidikan Indonesia, Bandung, Indonesia, 40154
[2] Department of Elementary School Teacher Education, Universitas Jambi, Jambi, Indonesia, 36361
✉Corresponding Author: penianggareni82@guru.smp.belajar.id

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ABSTRACT

Creative thinking is one of the skills that must be possessed by students in the 21st century. This study aims to investigate and describe students' creative thinking skills in completing the Cartesian Coordinate Skills Task (CCST). This research was conducted in one of the public junior high schools in Jambi City. The research subjects were six 8th grade junior high school students who have learnt by product differentiate instruction. The research subjects were divided into 3 categories based on the results of the Knowledge Question (KQ), namely high, medium, and low. Students' creative thinking skills were tested through CCST and the results were analyzed based on creative thinking indicators. The results of this study indicate that each subject tends to be able to show aspects of fluency and flexibility, but only three subjects are able to show aspects of novelty. In addition, from the three subjects, there is 1 subject in the low category who is able to show the novelty aspects.

Keywords: creative thinking; differentiated instruction; product

1. INTRODUCTION

Mathematics is one of the subjects that plays an important role in education and everyday life. The need to understand and be able to use mathematics in everyday life will continue to increase (Ferrini-Mundy, 2000). The Indonesian nation is facing the challenges of the industrial revolution 4.0 in the 21st Century, where Indonesian students are expected to have the competence to become democratic citizens and become superior and productive human beings in the 21st Century (Satria et al., 2022). To answer this challenge, the government through Kepmendikbudristek Number 56 of 2022 concerning Guidelines for Implementing Curriculum in the Context of Learning Recovery (Kemdikbudristek, 2022b) gives freedom to education units to choose to implement the Kurikulum 2013 in its entirety, the Kurikulum Darurat (simplified Kurikulum 2013), or Kurikulum Merdeka.

The purpose of National Education as stated in Article 3 of Law Number 20 of 2003 concerning the National Education System is to create human beings who believe and be pious to God Almighty, have noble character, healthy, knowledgeable, capable, creative, independent and become democratic and responsible citizens (Depdiknas, 2003). The National Education Goals in the Kurikulum Merdeka are stated in the Profil Pelajar Pancasila. Indonesian students are lifelong students who are competent, have character, and behave according to the values of Pancasila which consist of six dimensions, namely: faith and be pious to God Almighty, noble character, independent, worked together, global diversity, critical reasoning; and creative (Kemdikbudristek, 2022c, 2022a; Satria et al., 2022). This is in accordance with the demands of 21st Century Skills that must be possessed by students, namely critical thinking, creative thinking, collaboration and communication (Ohio Department of Education, 2015).

The current approach to learning mathematics, promotes the teaching of creative thinking to develop a deep conceptual understanding of mathematics, and many countries incorporate creative thinking explicitly into the curriculum (Aizikovitsh-Udi & Amit, 2011; Hadar & Tirosh, 2019; Mann, 2006), one of which is Indonesia. This means, one of the abilities that must be developed in a student through mathematics learning is creative thinking. Creative thinking is one of the most important skills in solving math problems or generating new ideas (Hadar & Tirosh, 2019), 21st century learning, and the key to effective learning (Egan et al., 2017; Jahnke et al., 2015; Nissim et al., 2016). Based on the 21st century framework, creative thinking can help students deal with the rapidly changing competencies in the world (Suherman & Vidákovich, 2022). Furthermore, according to PISA Mathematical creative thinking is a competency to be involved productively in learning, evaluating, and improving ideas that can produce new and practical solutions (OECD, 2019). Creative thinking skills must be used at the highest level to achieve more permanent learning and ensure interdisciplinary transition (Cenberci, 2018).

Creative thinking is the ability to develop unusual ideas according to goals (Anggareni & Hidayat, 2019; Hidayat & Anggareni, 2019; Yuli & Siswono, 2004), as well as habits of exploration, imagination, and intuition (Anggareni & Hidayat, 2019). Creative thinking is characterized by the creation of something new from the results of ideas, descriptions, concepts, experiences, and knowledge (Suherman & Vidákovich, 2022), not only generating and building ideas but also competencies needed by students (Lucas et al., 2012; OECD, 2019; Suherman & Vidákovich, 2022). Students' creative thinking can be assessed based on several important aspects of creative thinking, namely fluency, flexibility, novelty/originality (Anggareni & Hidayat, 2019; Hidayat & Anggareni, 2019; Silver, 1994; Sriraman & Lee, 2013; Torrance, 1963), elaboration, redefinition (Suherman & Vidákovich, 2022; Torrance, 1963). However, in this study only three aspects of creative thinking were used, namely fluency, flexibility, and novelty. Fluency is the ability to generate many ideas; flexibility is the ability to generate many ideas from various points of view; novelty is the ability to generate personal ideas that are different from most (Githua & Ng'eno, 2016).

In this study, fluency refers to the ability to display multiple presentations of written data. Multiple presentations of written data are related to the representation of the position of certain objects. Flexibility refers to the ability to represent objects and many different types of data presentation. Novelty refers to a way of demonstrating understanding in a way that is different from most. Creative thinking is very important to develop a deep conceptual understanding of mathematics (Hadar & Tirosh, 2019; Mann, 2006; Sheffield, 2013). But in reality, developing creative thinking is difficult (Hadar & Tirosh, 2019), teachers cannot directly teach creative thinking skills (Hadar & Tirosh, 2019; Sarrazy & Novotná, 2013), but teachers can create learning that can encourage creative thinking (Švecová et al., 2014). Creative thinking requires a stimulus (Ulfah et al., 2017), is student-centered (Kwon et al., 2006), produces something unusual or an original idea (Volle, 2018), as well as the types of materials, activities/tasks support (Hadar & Tirosh, 2019). One of the lessons that encourage creative thinking is differentiation learning. Differentiated Instruction has the potential to promote the abilities of all students (Prast et al., 2018). In addition, the research findings of (Palieraki & Koutrouba, 2021) concluded that there was an increase in the quality of learning outcomes and the level of active participation of students and due to differentiated learning.

Differentiated instruction is a varied learning approach to meet the diverse needs of students in the classroom (Prast et al., 2018; Shareefa & Moosa, 2020; Tomlinson, 2014). Furthermore, Smale-Jacobse et al. (2019) defines differentiated instruction as a teaching philosophy that is based on a deep respect for students, recognition of each other's uniqueness, and encouragement to help each learner develop. Differentiated instruction is a learning approach that combines various strategies, such as flexible grouping, adaptive instruction and progress that supports teachers to facilitate student learning (Deunk et al., 2018; Watts-Taffe et al., 2012). By offering learning resources, learning task, and goals that are specifically suited to each student's learning requirements, differentiated teaching enables all students to access the same classroom material or curriculum learning (Deunk et al., 2018; Watts-Taffe et al., 2012).

Students diversity in readiness, interest, and learning profile (Tomlinson, 1999; 11, 2001:45). Readiness refers to a student's relative prior knowledge to a certain understanding or skill. Interest refers to student's affinity, curiosity, or ambition to a certain topic or skills. Learning profile refers to how students learn, it might be influenced by preferences for IQ, gender, culture, or learning style. The uniqueness of Differentiated Instruction base on flexible teaching approach that can be modified with students' needs (Valiandes & Bermúdez Martínez, 2017). The teacher can change the content, process or product by analyzing the assessment data (Tomlinson, 1999:11, 2001:4). Contents refer to what students want to learn and how the material presented. Processes refer to how student get the knowledge or concept and to guarantee that students employ key skills to make important concepts and knowledge. Products refer to how students demonstrate and exhibit what they have learnt (Tom-linson, 1999: 11, 2001: 4).

At any moment during a lesson or unit, teachers may modify one or more curricular components (contents, processes, or products) based on one or more student's characteristics (readiness, interest, or learning profile). However, you do not have to distinguish every element in every way that is conceivable (Tomlinson, 1999: 11). Change a curriculum component only when you recognize a student need or you are certain that changing it will raise the likelihood that the learner will comprehend crucial concepts and use crucial skills more thoroughly as a consequence (Tomlinson, 1999: 11). On this research, subjects are students who got differentiated instruction on product. A product is a way for a student to demonstrate (and expand upon) what they have learned and are capable of doing after spending a significant amount of time learning. A demonstration or an exhibition might be the final product. A final product could be an exam or a visual presentation, such a photo essay with narration (Tomlinson, 1999: 43). The students demonstrate what they have learned and are capable of doing with final product about Cartesian Coordinates through Cartesian Coordinate Skills Task (CCST), students also use Google Maps to see accurate place of the certain objects. The product of CCST such as pictures/photos with hand or computer writing, pictures and audio recordings, video recordings or screen recording videos. Students can choose the form of the product that they want to upload according to their interest or ability.

2. RESEARCH METHOD

This study aims to describe students' creative thinking in completing skill assignments in product differentiated instruction. The data obtained in the form of products related to students' understanding of the material Cartesian coordinates. The data is qualitative data in the form of writing or student work. This study describes a phenomenon that occurs according to circumstances *(descriptive)*. Based on this, this research is a qualitative descriptive study. This study was conducted in one of the public junior high schools in Jambi City. The subjects in this study were students who were taught by product differentiated instruction. The selection of subjects begins with the provision of a Cartesian Coordinate Skills Task (CCST) which can be completed within the agreed time period. Then, prospective subjects are given Knowledge Questions in the form of multiple choices to see students' understanding of Cartesian Coordinates. KQ are given through Google Classroom and by utilizing the Quiz application to further challenge students and the results provided are accurate according to the time determined by the researcher. Based on these results, the prospective subjects were grouped into 3 categories, namely high (76-100), medium (51-75), and low (26-50). Furthermore, based on the product produced in CCST, two students from each category were selected to be used as research subjects. Subjects are selected based on the best product or display a certain phenomenon. The data collection instrument in this study was CCST. The CCST can be seen in **Figure 1**.

TUGAS KETERAMPILAN KOORDINAT KARTESIUS (TKKK)

Untuk mendemonstrasikan pemahaman ananda terkait Koordinat Kartesius, silahkan ananda mengerjakan tugas projek dengan langkah sebagai berikut.

1. Silahkan ananda menyelidiki posisi rumah Ananda menggunakan aplikasi google maps. Tentukan rumah Ananda sebagai titik asal (0,0).
2. Berdiskusilah dengan seseorang, anggota keluarga, atau orang lain untuk menggunakan topik Koordinat Kartesius untuk melihat posisi objek lain berdasarkan tampilan google maps Ananda. Pilihlah 3 objek yang ada disekitar.
3. Silahkan representasikan pemahaman mu terkait Koordinat Kartesius berdasarkan penyelidikanmu menggunakan google maps dalam beberapa penyajian (misal koordinat kartesius, tabel, dsb).
4. Tentukan koordinat suatu titik dengan menggunakan titik acuan (0,0) dan (a,b).
5. Demonstrasikan pemahaman ananda terkait bidang koordinat kartesius berdasarkan penyelidikanmu menggunakan google maps dalam bentuk gambar/foto berupa tulisan tangan atau komputer, gambar dan rekaman audio, video rekaman atau video rekaman layar. Silahkan ananda pilih bentuk produk yang ananda upload sesuai minat ananda.

Figure 1. The Cartesian Coordinate Skills Task (CCST)

3. RESULTS AND DISCUSSION

3.1 Fluency

In this study, fluency refers to the ability to display multiple presentations of written data. Multiple presentations of written data are related to the representation of the position of certain objects. The presentation of data includes, among others, sketch (google maps), Cartesian coordinates, tables. etc. The fluency aspect of each subject can be seen in **Table 1**.

Table 1. Analysis CCST Based on Fluency Aspects

Category	Subjects & KQ Values	Presentations of Written Data
High	S1 (100)	5
	S2 (100)	4
Medium	S3 (73)	4
	S4 (73)	4
Low	S5 (36)	4
	S6 (36)	4

Table 1 is a summary of the fluency aspects of the six subjects. Based on table 1, in each category it can be seen that the number of data presentations performed by each subject is four, except S1. This is because, S1 does not only present data in written form but also presents data in the form of an explanation video about the student's understanding of Cartesian Coordinates by utilizing the google maps application. Each subject category tends to present data in the form of sketch (google maps), Cartesian Coordinates and tables. In addition, the table presented consists of two tables, the subject not only displays his understanding of the coordinates of the point based on the origin (0, 0) but also to a certain point (a, b). In the high category, the subject tends to be able to present at least four data presentations and the subject tends to present the data correctly regarding their understanding of the CCST results. The reason is the subject has understood the Cartesian coordinate material which can be seen from the KQ value of the two subjects of 100. In the medium category, the subject tends to be able to present four data presentations and the subject tends to present the data correctly regarding their understanding of the CCST results, although in the KQ results the two subjects doing mistakes in understanding the indicator, namely determining the position of certain reference point (a, b), but the subject can show their understanding correctly in doing CCST. From figure 2 it can be seen that the subject is confused about where to move, starting from Gentala Arsy or Muara Jambi? So that the subject made an error and moved the point from Gentala Arsy to Muara Jambi, it should have been the other way around.

9. Diketahui Koordinat Gentala arsy dan Muara Jambi berturut-turut adalah (-2, 3) dan (1, 7). Posisi gentala Arsy terhadap muara jambi (titik acuannya muara jambi) adalah ....

Arel Praditya's response	Correct Answer
(3, 4)	(-3, -4)

Figure 2. The Snapshot of High Categories Subject Answers on Knowledge Questions (KQ)

Based on the results on the CCST, subjects in the medium category can write down the data presentation correctly. The reason is CCST was collected after the subject did the KQ, so that the subject could find out his mistake. Based on interview, subjects feel challenges with CCST because they can use their knowledge in daily life and using application (google maps). However, from Figure 4, it can be seen that S3 still has a mistake in determining the position of a point with respect to a certain reference point (a, b) using the formula. It can be seen that based on the CCST that S3 presents in the table of point coordinates to a certain reference point (a, b), S3 changes the given formula from the minus operation (-) to the (+) operation. S3 is confused because S3 uses a reference point (0,-5) so that when using the formula, S3 tends to see the y-ordinate as the sum of y1 and y2. In fact, the positive sign (+) is actually obtained because there is a subtraction in negative numbers, so that initially (0-(-5)) becomes (0 + 5). The S3' answer was not wrong, but the final conclusion regarding the general formula was wrong because S3 was fooled by the negative sign at the reference point.

NO	Koordinat Titik Terhadap titik asal (0,0)/(x1,y1)	Posisi terhadap titik acuan Kos-kosan Melani Putri (0,-5) (x2,y2)		Rumus (x1+x2, y1+y2)
		Posisi	Koordinat	
1	Rumah (0,0)	0 satuan ke kanan dan 5 satuan ke atas	(0, 5)	(0+0, 0+5)(0,5)
2	Illa Santan (5,-6)	5 satuan ke kanan dan 11 satuan ke atas	(5, 11)	(0+5, 5+6)(5,11)
3	Putri Tunggal Mini Market (4,2)	4 satuan ke kanan dan 7 satuan ke atas	(4, 7)	(4+0, 2+5) (4,7)

Figure 3. CCST S3 Snapshot

In the low category, subjects tended to be able to present four data presentations, but both subjects made errors in presenting data related to their understanding of the CCST results. Based on Figures 4 and 5, it can be seen that the two subjects did not understand several indicators, namely determining the distance of the point to the x axis (S6) or Y axis (S5 and S6), determining the position of the point to the origin (0,0) (S5), the coordinates of the point to the origin (S6) and determine the position of the point with respect to a certain reference point (a, b).

4. Diketahui titik B(4, -8). Posisi titik B terhadap titik asal adalah ....

Aimar J's response	Correct Answer
8 satuan ke kiri dan 4 satuan ke atas	4 satuan ke kanan dan 8 satuan ke bawah

9. Diketahui Koordinat Gentala arsy dan Muara Jambi berturut-turut adalah (-2, 3) dan (1, 7). Posisi gentala Arsy terhadap muara jambi (titik acuannya muara jambi) adalah ....

Aimar J's response	Correct Answer
(3, 4)	(-3, -4)

Pertanyaan

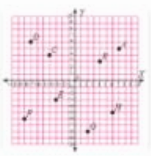
11. Diantara titik-titik berikut yang berjarak "3" satuan terhadap sumbu "y" adalah...

Aimar J's response	Correct Answer
(6, 3)	(-3, 5)

Figure 4. S5 Answer Highlight on Knowledge Questions (KQ)

1. Jarak titik A(-1, 4) terhadap sumbu X adalah ... satuan

Firas Ahmad ihsan's response	Correct Answer
3	4



3. Koordinat titik D adalah ....

Firas Ahmad ihsan's response	Correct Answer
(-7,-6)	(-7, 6)

9. Diketahui Koordinat Gentala arsy dan Muara Jambi berturut-turut adalah (-2, 3) dan (1, 7). Posisi gentala Arsy terhadap muara jambi (titik acuannya muara jambi) adalah ....

Firas Ahmad ihsan's response	Correct Answer
(3, -4)	(-3, -4)

11. Diantara titik-titik berikut yang berjarak "3" satuan terhadap sumbu "y" adalah...

Firas Ahmad ihsan's response	Correct Answer
(-7, -3)	(-3, 5)

Figure 5. S6 Answer Highlight on Knowledge Questions (KQ)

Based on the results on the CCST, it can be seen that subjects in the low category can write down the data presentation correctly on the indicator, determine the distance of the point from the x or Y axis, determine the position and coordinates of the point to the origin (0,0). Even though the subject did not do the KQ correctly on these indicators. This is because the CCST was collected after the subject did the SP, so that based on this the subject could find out his mistake. However, when the indicator determines the position of the to a certain reference point (a, b), both subjects made an error in presenting the data. This can be seen based on CCST S5 in **Figure 6**.

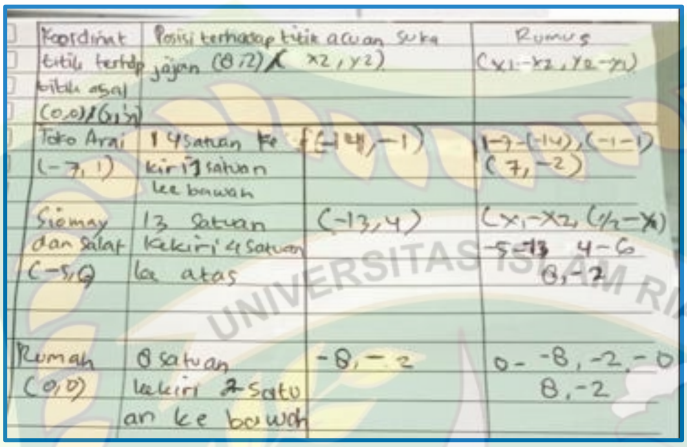


Figure 6. CCST S5 Snapshot

In **Figure 6**, it can be seen that S5 made a mistake in determining the coordinates of a point to a certain references point (a, b). S5 also used the formula to determine the coordinates incorrectly, in contrast to S6. In **Figure 7**, it can be seen that S6 did not make a mistake in determining the coordinates, it is just that the table shown by S6 is the coordinates of the point to the origin (0, 0).

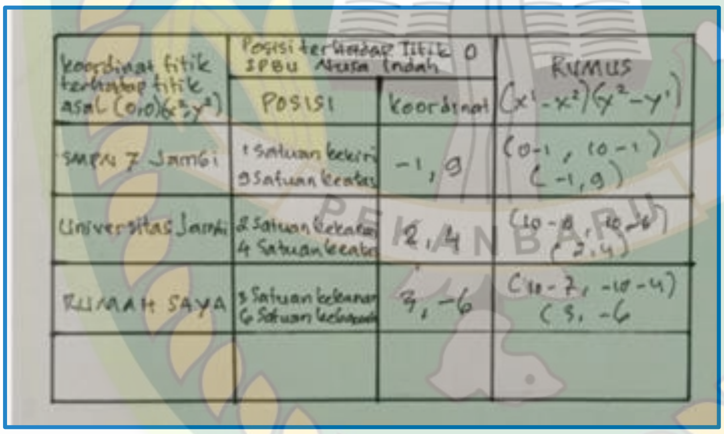


Figure 7. CCST S6 Snapshot

3.2 Flexibility

In this study, flexibility refers to the ability to represent objects and many different types of data presentation. Represent objects related to the position of the object on the x or y axes. Meanwhile, the type of data presentation is related to the presentation of data in the form of sketch/google maps, cartesian coordinates, tables, or videos. Look at the following table to see fluency aspect of each subject.

Table 2. Analysis CCST Based on Flexibility Aspects

Category	Subjects & KQ Values	Represent of Objects	Data Presentation
High	S1 (100)	3	4
	S2 (100)	4	3
Medium	S3 (73)	4	3
	S4 (73)	4	3
Low	S5 (36)	4	3
	S6 (36)	4	3

Based on **Table 3**, it can be seen that the subjects in each category have a tendency for the level of flexibility in presentation to be four, except for S1. This is because, students are asked to determine 4 objects on google maps that will be presented in various ways to see students' understanding of the Cartesian Coordinate material. There are 2 objects represented by S1 on the same axis. In addition, the flexibility in presenting data, subjects in each category tend to display

3 types of data presentation, except S1. The three types of data presentation are in the form of handwritten location sketch or Google Maps screenshots, presenting objects at Cartesian coordinates, and presenting objects on table. In contrast to S1, after presenting in these three ways, S1 also presents using a video that explains S1's understanding of the Cartesian Coordinate material.

3.3 Novelty

Novelty refers to a way of demonstrating understanding in a way that is different from most. Look at the following table to see novelty aspect of each subject.

Table 3. Analysis CCST Based on Novelty Aspects

Category	Subjects & KQ Values	Ways of Demonstrate
High	S1 (100)	1
	S2 (100)	1
Medium	S3 (73)	0
	S4 (73)	0
Low	S5 (36)	0
	S6 (36)	1

Based on **Table 4**, it can be seen that there are only 3 subjects who can show novelty, namely S1, S2, and S6. Subjects in the high category tend to show novelty, while the subjects in the medium and low categories have not been able to show the novelty aspect, except for S6. A snapshot of CCST S1 can be seen in Figure 8. The screenshot is a 3 minute 25 second video screenshot, which can be accessed at the link https://bit.ly/ProdukTKKK

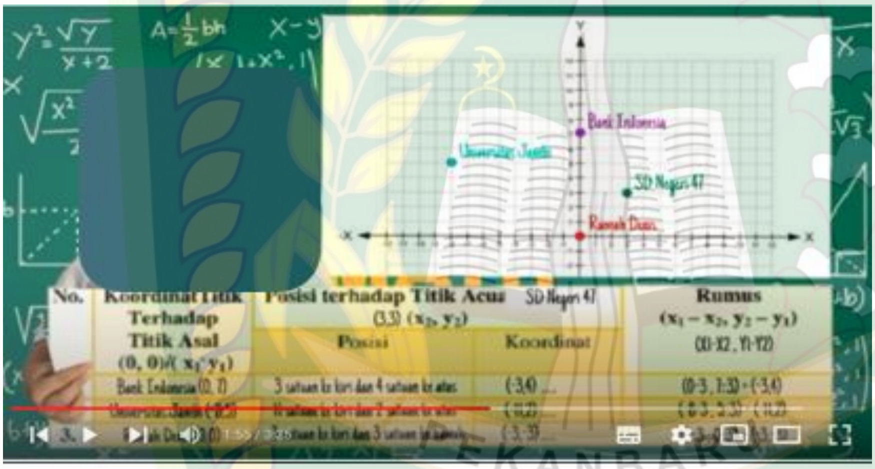


Figure 8. CCST S2 Snapshot

A snapshot of the S6 CCST can be seen in Figure 9. The CCST image produced is actually quite simple, but of most subjects and even students who are working on CCST, only S6 combines Google maps screenshots and the coordinate system, so the position of the selected object is correct, precision according to the actual situation. This means, even though the subject is in the low category, the subject can maximize their creative potential by being given the opportunity to explore more potential and problems. This opinion is in accordance with Cenberci (2018) which states that the opportunity to develop creative thinking skills and have more time to design creative products is very important to determine how to use the tendency of creative thinking skills and the factors that will activate these tendencies. Creative thinking is characterized by creating something new from results, ideas, descriptions, concepts, experiences, and knowledge which includes fluency, flexibility, originality, and elaboration (Suherman & Vidákovich, 2022).

Figure 9. CCST S6 Snapshot

3.4 Discussion

Based on the results of the research that has been described above, although the subject cannot do the KQ, the subject tends to try to do their best in doing the CCST. This shows that product differentiated instruction can improve students' abilities, including creative thinking. Differentiated instruction has the potential to improve the achievement of all students (Prast et al., 2018) and develop students' creative thinking skills (Cenberci, 2018).In addition, creative thinking can be developed with good teaching planning (Anggareni & Hidayat, 2019; Gomez, 2007). Of course, the learning planning must pay attention to the needs of students in order to make it easier for students to learn (Nasution, 2007). Giving freedom to students to take advantage of the potential that exists within them, it will happen extraordinary things that are unthinkable by an educator. Therefore, as educators, they should prepare learning that is able to explore the potential of students so that students' creative thinking is honed since school. In the end, students will get used to coming up with creative ideas in solving problems both related to learning and everyday life.

In addition, based on the results of further interviews with S1 and their parents, data was obtained that parents have an important role in learning differentiation. This opinion is in accordance with (Smutny, 2011). which states that in many ways, differentiated instruction (especially for children) begins at home. This is because, parents are the people who know best, know their strengths and weaknesses, their passions and interests, a lot of knowledge and insight about how, when, and why their children learn well and into situations or experiences that tend to lead to negative outcomes, confidence or disappointment, fear or determination, fear or excitement (Smutny, 2011). The development of the potential of students cannot be separated from the intervention of parents. This is in accordance with the core of the Kurikulum Merdeka. The Ministry of Education and Culture stated the need for synergistic collaboration between educational programs carried out with the family environment (Wahdani, 2020). In this case, the guideline is the Tri Center of Education initiated by Ki Hajar Dewantara, which demands the harmony of education in education units, families, and communities (Mustaghfiroh, S., 2020).

4. CONCLUSION

Based on the results and discussion, there are several conclusions. First, subjects in each category tend to be able to show aspects of flexibility, but only subjects in high categories tend to show aspects of novelty (novelty). Second, there is one low category subject who is able to show aspects of novelty (novelty), even though it is a simple thing, but if creative thinking is honed through differentiated instruction, the learning carried out might increase achievement and develop students' creative thinking. Third, giving freedom to students in utilizing the potential that exists within themselves, it will increase student creativity. Fourth, as educators, they should prepare learning that is able to explore the potential of students so that students' creative thinking is honed since school. In the end, students will get used to coming up with creative ideas in solving problems both related to learning and everyday life. Fifth, synergistic cooperation is needed between the education unit and the family environment to implement differentiated instruction which is the core of an free curriculum (Kurikulum Merdeka). Some suggestions that researchers can do are, first, CCST should give students more freedom to explore students' understanding of Cartesian Coordinates without limiting individual or group tasks, many objects to be achieved, or ways of presenting data according to students' understanding. Second, this CCST was done online, so that the scaffolding provided was not optimal because it was only through the WhatsApp application or zoom meeting, students should be guided directly to see their progress in working on the CCST. Third, provide learning that provides opportunities for students to demonstrate their understanding in a way that is unique and appropriate to the characteristics of students, not only about cartesian coordinate but also other material.

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AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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Research Article

Assessing students' self-efficacy when solve mathematical problem based on gender

Syamsu Alam✉, **Mega Teguh Budiarto, & Tatag Yuli Eko Siswono**

State University of Surabaya, Surabaya, Indonesia, 60231
✉Corresponding Author: syamsualam@mhs.unesa.ac.id | Phone: +62852-5524-4848

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ABSTRACT

Self-efficacy, problem solving, and gender differences are aspects that many researchers concern to today. Therefore, the purpose of this study was to describe the profile of students' self-efficacy in solving problems based on gender. We used a qualitative approach with exploratory research to answer the research objectives. We used the Mathematical Ability Test (TKM) instrument, Mathematical Problem-Solving Tasks (TPMM), and interview guidelines to consider the selected subjects. Next, two students were selected (14 years old, of different gender, and had good math skills) to participate in the study. Data from transcripts and student work were used to perform data analysis. The results revealed that there were fundamental differences between the two subjects based on three dimensions of self-efficacy (magnitude, strength, and generality). This is discussed further in this article. Finally, we suggest to explore the influence of regional culture on students' self-efficacy in the classroom.

Keywords: self-efficacy; gender; mathematical problem

1. INTRODUCTION

Problem solving is one of the important skills developed by students at every level (Lyn D. English & Jane M. Watson, 2016; Shanta & Wells, 2022; Sriraman & Kaiser, 2006). This ability encourages students to not only explore or study mathematics, but also helps them apply it in other fields of study, and in everyday life. The success of students in solving problems is influenced by many factors, such as prior knowledge, belief in achieving success, background of the problem, and students' cognitive and affective aspects (Henry et al., 2008; Ndlovu et al., 2020; Pintrich & De Groot, 1990) . Of the various factors that can affect success in solving problems, it appears that one of them is self-efficacy, which is related to affective, desire, and motivational aspects (Bandura, 2010; Williams & Williams, 2021). Of course, from this aspect, it was found that there was a significant relationship between affective and problem solving for students (Singer et al., 2017; Singer & Voica, 2013; Voica et al., 2020). This shows that the affective aspect cannot be ignored in learning mathematics.

Self-efficacy is one of the factors or aspects that determine success in solving problems (Ramdass & Zimmerman, 2008). Students with low self-efficacy will avoid lessons that have a lot of tasks, especially challenging tasks. In contrast to students with low self-efficacy, students who have high self-efficacy have a great willingness to complete the tasks given (Williams & Williams, 2021). In this case, students are required to increase their confidence in solving problems. In addition, when students study, they must also be able to appreciate the usefulness of mathematics such as students who have attention, curiosity, interest in learning mathematics have a tenacious attitude and confidence in solving problems (Sutama et al., 2021; Voica et al., 2020). Therefore, students' self-efficacy can shape students' ability to solve problems, especially in math problems. Furthermore, most students perceive mathematics as a difficult, stressful, and boring subject, where high self-efficacy of students is able to help them reduce and even eliminate these problems (Supardi US, 2010). Therefore, student self-efficacy needs to be developed, so that it can foster self-confidence in dealing with problems, including solving math problems.

A number of studies have shown that students' efficacy and self-confidence related to mathematics and problem solving will significantly affect problem solving ability (Callejo & Vila, 2009; Phan & Ngu, 2016; Usher, 2009). Self-efficacy can determine students' actions in achieving something they want, including solving math problems. Self-efficacy is related to students' self-confidence in carrying out tasks based on their abilities. Students sometimes cannot show their abilities because students are often not sure that they are able to complete the tasks given by the teacher. One of the findings that show this phenomenon is the result of the author's interview in the preliminary study, which is as follows:

P: What do you think about this question?
S: In my opinion, this question is quite difficult
P: Do you want to solve questions like this? Why?

S: Yes sir. I feel challenged to try to solve it
P: Can you do it?
S: Maybe I can, I'll try first, sir.

This interview excerpt shows that the subject considers that the question given is quite difficult question, but he still wants to solve the problem. In addition, the subject has doubts about his ability to solve the given problem and prefers to try it to ensure his confidence. The belief possessed by the subject will determine their actions, influencing their efforts and hard work when they want to achieve the expected goals. The belief possessed by students can give encouragement to try or not, whether to try or not if they fail, whether they can form resilience or give up easily (Hegedus et al., 2016). In addition, self-confidence about their ability to solve problems can generate an optimistic attitude in dealing with problems (Gao, 2020; Williams & Williams, 2021). When students have confidence that they can achieve the expected goals, then these students will tend to try to pour all their abilities in achieving the expected goals.

2. LITERATURE REVIEW

2.1 Self-efficacy as an important aspect in student's problem solving

Self-efficacy refers to a student's belief that he or she is capable of performing certain actions. Self-efficacy refers to the component of self-confidence that a person has in dealing with a situation that will come, which contains uncertainty, cannot be predicted, and is often full of pressure (Kaskens et al., 2020; Zulkarnain et al., 2020). Although self-efficacy has an influence on a person's actions, self-efficacy also combines with previous environment and behavior. Mathematics self-efficacy is an individual's belief or perception related to his ability in mathematics (Öztürk et al., 2020; Tossavainen et al., 2021). Mathematics self-efficacy in this study is the students' self-confidence about their ability to carry out mathematical tasks. Students' belief that they will be successful in completing mathematical tasks can raise enthusiasm and increase effort and tenacity in completing mathematical tasks. In addition, students who have confidence that they are able to complete mathematical tasks tend to be able to develop themselves in solving more complicated mathematical tasks.

The dimensions of self-efficacy that can be used as a basis for measuring one's self-efficacy are magnitude, strength, and generality (Dixon et al., 2020). Magnitude is related to the individual's belief in the ability to solve problems/tasks (questions) according to their level, namely how difficult the problem is according to their thinking. Strength is related to the stability of the heart and the strength or weakness of a person's belief regarding his abilities in completing tasks. Generality relates to the breadth of the tasks performed. Furthermore, Ramdass & Zimmerman (2008) state that the dimensions of self-efficacy involve: (1) Level is related to the level of difficulty of a particular task, such as increasing difficulty in math addition problems; (2) Generality is an assessment of a person's ability to do several tasks or activities such as math problems with different materials; and (3) Strength is the strength of one's belief in doing certain tasks. When students believe that they are proficient in mathematics, students will increasingly try to solve mathematical problems. Students' mathematics self-efficacy can determine future career choices (Goulet-Lyle et al., 2020; Ndlovu et al., 2020; Siegle & McCoach, 2007). In this case, mathematics self-efficacy determines whether students will choose a mathematics-related career in college or not. Students who believe that they are able to solve mathematical problems will tend to develop their self-efficacy to try and solve more complex mathematical problems (Williams & Williams, 2021). Self-efficacy can lead to different behavior in each individual, even they have the same abilities. This is because self-efficacy can affect students in determining goals, overcoming problems, tenacity and choice in overcoming problems. The indicators or characteristics of self-efficacy that are used as measures in determining student self-efficacy in this study adapt the previous theories (Bandura, 2010; Dixon et al., 2020), which are shown in **Table 1.**

Table 1. Indicators of Self-Efficacy in Solving Mathematical Problems

Dimensions	Indicators
Magnitude	Students' views on math problem solving tasks
	Students can find out the level of difficulty of math problem solving tasks.
	Students have difficulty in completing mathematical problem-solving tasks
	Success in completing mathematical problem-solving tasks.
	Students are confident in their ability to complete mathematical problem-solving tasks
	Students can use all the information to complete math problem solving tasks
	Students check the work
	Planning in completing math problem solving tasks
	Students have a plan in completing mathematical problem-solving tasks
	Students have confidence in planning and completing mathematical problem-solving tasks
Strength	Students have a commitment (diligent/independent/enthusiastic) to complete mathematical problem-solving tasks.
	Students have readiness in overcoming/completing mathematical problem-solving tasks.
	Students have experience that can support in completing mathematical problem-solving tasks.
Generality	Students have mathematical ideas that are used in solving mathematical problem-solving tasks.
	Students know the mathematical ideas used in solving mathematical problem-solving tasks
	Students are confident in the mathematical ideas used in solving mathematical problem-solving tasks
	Students have confidence in their ability to complete mathematical problem-solving tasks with similar or different contexts.

2.2 Research Rationale

Problem solving can train students in the use of various mathematical principles, concepts, and skills that have been or are being studied, so that they can solve mathematical problems and even problems in everyday life (Filloy et al., 2010; González-Calero et al., 2015; Soneira et al., 2018). Problem solving develops cognitive skills, problem solving fosters creativity, problem solving is part of the process of applying mathematics, and problem solving motivates students to learn mathematics (Nolte & Pamperien, 2017). One of the affective factors that are considered to be able to influence students' problem solving is "mathematics self-efficacy" (Güven Akdeniz & Argün, 2021). Self-efficacy is an aspect of self-knowledge that is influential in everyday life. This shows that self-efficacy can influence a person in determining actions, so that they can achieve goals. Self-efficacy in mathematics is a student's belief related to ability in mathematics.

Students often cannot show their achievements optimally according to their abilities. This can happen because students do not have confidence in themselves in terms of completing the tasks given to them. Students who have high self-efficacy will believe in their abilities that they can do something to change the events around them and prefer to imagine success (Renninger et al., 2011; Williams & Williams, 2021). Students who have low self-efficacy will consider themselves unable to do everything around them and imagine failure more than things that can hinder the achievement of success. Students who have low self-efficacy will more easily give up, while students with high self-efficacy will try harder to overcome existing challenges. Students who perceive themselves as capable will try and are committed to achieving their goals. Furthermore, mathematics is a form of culture, which has actually been integrated into all aspects of people's lives wherever they are (Bishop et al., 2014). Basically, mathematics is a symbolic technology that exists in a cultural skill or activity environment. This shows that cultural background affects a person's mathematical ability because they do something based on what they see and feel. Mathematics education has actually been integrated with the life of society itself. Some ethnomathematics experts assume that basically the development of mathematics is inseparable from the culture and values that exist in society. Indonesia, which consists of various ethnic groups, has different cultures. South Sulawesi, for example, is inhabited by several ethnic groups and has different cultures. One of the ethnic groups in South Sulawesi is the Bugis ethnic group, which has the largest population. Bugis society has a system of life and values that are guided in domestic life and in society. The main values in Bugis culture include lempu *(honesty),* amaccang *(intellect),* assitinajang *(property),* agettengeng *(determination),* reso *(effort),* siri *(shame principle).* These values are passed down through Papangaja *(advice)* and paseng *(mandate).*

3. RESEARCH METHOD

3.1 Types of research

This study aimed to explore the self-efficacy of junior high school students in solving math problems based on gender. Students' self-efficacy in solving math problems could be seen from students' behavior when they completed math problem solving tasks which could reflect students' mental activity. Student behavior would be tracked when faced with mathematical problem solving tasks and in-depth interviews. Therefore, this research included exploratory research with a qualitative approach (Creswell, 2012; Yin, 2011).

3.2 Participants

This study was conducted in public schools in the central part of Indonesia. The selection of this area was based on the closeness of the community's culture to the Bugis ethnicity, so that it matched the characteristics of the desired subject in this study. The desired subjects in this study were students of the Bugis ethnicity, namely students with a background of Bugis ethnic descent (Father and Mother of Bugis ethnicity). The participating students were aged 10 – 14 years and currently pursuing secondary education. We assigned research subjects based on gender by taking into account the equality of students' mathematical abilities. Previously, students were given Mathematics Ability Test (TKM) questions to determine their mathematical abilities. Then, Students were selected with mathematical score at a difference of less than 5 for the range 0-100. The main criterion was the male subject and the female subject with relatively similar mathematical ability. In addition to the things mentioned above, the determination of the subjects carried out in the study also considered the character of the students, namely students having good oral communication based on observations in class and information from the mathematics teacher in the class. This was done because teachers knew better the characteristics of their students. In addition, students selected as subjects were students who were willing to spend their time outside of class hours to be interviewed, so that the research subjects were not disturbed by their study time in class, and interviews could be carried out according to agreement with the research subjects. The participating subjects are shown in **Table 1**.

Table 1. Description of research participants

No	Subject Candidate Name	Gender	TKM Value
1	CSP-1 (UM)	P	90
2	CSP (AM)	P	84
3	CSP-3 (HU)	P	77
4	CSP-4 (RM)	P	77
5	CSP-5 (NA)	P	74
6	CSP-6 (AL)	P	73
7	CSP-7 (ZA)	P	72
8	CSL-1 (FI)	L	87
9	CSL-2 (FE)	L	85
10	CSL-3 (AG)	L	70

3.3 Research Instruments

The study instrument consisted of the main instrument and the supporting instrument. The main instrument of this research was the researchers himself, because it was the researchers who planned, collected data, prepared observation or study documentation, then analyzed, interpreted, and reported the research data. Researchers who acted as instruments would make it easier to extract interesting information, including information different from the others (interesting findings), information not planned in advance, or information not unexpected in advance or not common. This study also used supporting instruments, namely the Mathematical Ability Test (TKM), Mathematical Problem Solving Tasks (TPMM), and interview guidelines. Mathematical Ability Test (TKM) was used to obtain one male subject and one female subject with relatively the same level of ability. Mathematical Problem Solving Tasks (TPMM) was used to explore students' self-efficacy when solving mathematical problems. The interview guide was used as a reference to reveal students' self-efficacy in solving math problems. The interview guide contained open-ended questions that referred to the research problem.

Supporting instruments used needed to be developed before being used in research. The development of these supporting instruments was carried out as follows. First, the Development of Mathematical Ability Test (TKM) in this study aimed to control the mathematical ability of male and female subjects, so that research subjects had the same or relatively the same level of mathematical ability. The Mathematical Ability Test (TKM) in this study was arranged in the form of an essay test containing 10 National Examination (UN) questions, namely in 2013, 2014, 2016, 20017, and 2018. The scoring technique used was 0–100 scoring. The National Examination questions were chosen based on the consideration that the National Examination questions had passed the national validity and reliability test, so that they could measure the achievement of student competencies, in this case the students' mathematical abilities. Meanwhile, the descriptive form questions were chosen because the description questions could show how students' abilities in the process of solving the Mathematics Ability Test (TKM) questions were.

Second, the Mathematical Problem Solving Task (TPMM) was an assignment sheet given to students which was a mathematical problem in the form of non-routine story questions, containing the concepts of rectangles and algebra (See Figure 2). Third, data mining through interviews was carried out by combining structured and unstructured interviews. A structured interview was an interview in which the interviewer set his own problems and questions to be asked in the hope of finding answers to the allegations. Furthermore, to find non-standard information and to go deeper into a problem, researchers needed to emphasize the possibility of irregularities, unusual interpretations, and reinterpretations, therefore unstructured interviews were conducted. In unstructured interviews, questions were not prepared in advance but were adapted to the unique circumstances and characteristics of the respondent. To obtain information according to the research objectives, the development of interview guidelines referred to several provisions, namely: (1) the questions asked did not directly mention the research indicators, (2) the questions asked were open-ended. For example, "tell me what you're thinking!", (3) the question asked was adjusted to the subject's response in the form of writing or explanation, (4) if the subject's response to the question asked was not in accordance with the research objectives and the response given was not interesting to reveal according to the researcher's analysis, then the question was asked with different sentences, but still in the core of the problem. However, if the response given by the subject was interesting to reveal even it was not in accordance with the research objectives, then the researchers asked exploratory questions. This was done to obtain information that could be used as interesting findings or data verification, (5) the questions asked were exploring and avoiding guiding nature, which was done to avoid researcher intervention on the subject.

Ibu Sitti menggunting daun pisang yang akan digunakan membungkus *barongko*. Lebar daun pisang adalah setengah dari panjangnya, dan kelilingnya adalah 90 cm. Tentukan luas daun pisang yang akan digunakan untuk membungkus kue *barongko* tersebut!

Translated

> Mrs. Sitti cuts a banana leaf which will be used to wrap barongko (Bugis' traditional food). The width of a banana leaf is half of its length, and its circumference is 90 cm. Determine the area of the banana leaf that will be used to wrap the barongko!

Figure 2 Problem Solving of Task Instruments

3.4 Data Collection Procedure

The data collection procedure in this study was transcripts of interviews and student work. First, students were given a Mathematical Problem Solving Task (TPMM), then the subject was asked to tell in detail the subject's self-efficacy (belief in his own ability) in completing the Mathematical Problem Solving Task (TPMM). Second, interviews in research were used to reveal or dig up information about the subject's self-efficacy in solving mathematical problems. Therefore, the implementation of the research used Mathematical Problem Solving Tasks (TPMM) and interviews. To obtain valid and reliable data, validity and reliability tests were also carried out. Testing the validity of the research was carried out by testing the credibility of the data through time triangulation, checking peers, and checking referential adequacy. Time triangulation was carried out by giving Mathematical Problem Solving Tasks (TPMM) at different times and conducting reinterview, so that consistent data were obtained. Examination/checking with colleagues through discussions with friends, with the intention that the researcher maintained an open and honest attitude and provided an opportunity to explore something arising from the researcher's thoughts regarding the study of Bugis ethnic students' self-efficacy in solving math problems in terms of gender. Referential adequacy meant the use of an audio recorder equipped with interview transcripts that could be used to check the correctness of the interpretation of the data.

The study dependability test was carried out by independent research auditors, namely experts who were indirectly involved in this research, starting from the researchers determined the focus of the problem, entered the field, determined the data source, conducted data analysis, and tested the validity of the data to making conclusions. The dependability test in this study was carried out by the supervisor. Transferability testing in research was carried out by compiling a detailed, clear and systematic report on research results (dissertation), including theory suitability, subject selection, development of supporting instruments, collecting data in accordance with theory, conducting data analysis, and reporting research results, especially about students who became research respondents. Confirmability (objectivity) of the study would be fulfilled automatically if the dependability test of this study was met. After the data were collected, the validity of the data was checked to obtain valid data.

3.5 Analysis of Data

The data analysis process started from the time the researchers collected data to complete the task in the field. Data analysis was intended to sharpen the focus of observation and deepen problems that were considered important and relevant to the research problem. The collected data were still in the form of recordings, then should be transformed into interview transcripts. Activities in data analysis were data reduction, data presentation, and drawing conclusions (Miles et al., 2018). The data analysis activities were not hierarchical in nature, but were a chain of interacting activities, starting from before, during, and after data collection. The results of the interview transcripts shown by the subject were analyzed with the following steps. ***First***, analyzing the data, the data from the interview transcripts were reviewed by reading repeatedly. ***Second***, performing data reduction by sharpening, selecting, focusing, discarding, and organizing data in a way where final conclusions could be drawn and verified. The data collected were usually highly variable, irregular, and complex. Therefore, it was necessary to reduce data by making a summary consisting of the core, process, and questions that needed to be kept within the research objectives. ***Third***, data presentation. The presentation of the data was directed so that the reduced data were organized and arranged in a relationship pattern, so that they would be easier to understand for planning further research work. In this step, the researchers tried to organize the relevant data into information that could be concluded and had a certain meaning. Fourth, checking the validity of the data after the data were collected. Fifth, the analyzing students' self-efficacy based on gender, namely analyzing the similarities and differences between male and female subjects in solving mathematical problems. Finally, drawing conclusions based on findings and data verification. The initial conclusions put forward were still temporary and would change if no supporting evidence was found at the next stage of collection. If the conclusions put forward at the initial stage were supported by valid evidence and were consistent with the conditions found when the researchers went to the field, then the conclusions obtained were credible conclusions

4. RESULTS AND DISCUSSION

4.1 Results

Based on the results of the study, first coded the self efficacy indicators to facilitate the data analysis process (See **Table 2**).

Table 2. Coding of self-efficacy indicators in solving problems

Dimensions	Indicators	Code
Magnitude	Students' views on math problem solving tasks	
	Students can find out the level of difficulty of mathematical problem-solving tasks.	L11
	Students have difficulty in completing mathematical problem-solving tasks	L12
	Success in completing math problem solving tasks.	
	Students have confidence in their ability to complete mathematical problem-solving tasks	L21
	Students can use all the information to complete math problem solving tasks	L22
	Students check the work	L23
	Planning in completing math problem solving tasks	
	Students have a plan in completing mathematical problem-solving tasks	L31
	Students have confidence in planning and completing mathematical problem-solving tasks	L32
Strength	Students have a commitment (diligent/independent/ enthusiastic) to complete math problem solving tasks.	St1
	Students have readiness in overcoming/completing mathematical problem-solving tasks.	St2
	Students have supportive experiences in completing math problem solving tasks.	St3
Generality	Students have mathematical ideas that are used in solving mathematical problem-solving tasks.	
	Students know the mathematical ideas used in solving mathematical problem-solving tasks	G11
	Students believe in mathematical ideas used in solving mathematical problem-solving tasks	G12
	Students have confidence in their ability to complete mathematical problem-solving tasks with similar or different contexts.	G2

Data explanation of male subjects (SL)

For the magnitude dimension, SL had an initial description of the given problem. Thus it can be concluded that SL had an initial view of the level of difficulty of the mathematical problem solving task being faced. Data from interviews in SL.1.M.29, SL.1.M.37, and SL.1.M.40 showed that SL had difficulties in solving the problems given, even though he understood the information from the questions easily. Therefore, it can be concluded that SL had difficulty in completing mathematical problem solving tasks. Data on SL.1.M.19, and SL.1.M.49 showed that SL used his knowledge of the problems presented to solve problems. Thus, it can be concluded that SL had confidence in being able to successfully complete mathematical problem solving tasks. Interview data on SL.1.M.38 and written answers showed that SL used the information known in the questions to achieve the objectives of the questions. Based on these activities, it can be concluded that SL could use all information to complete mathematical problem solving tasks. The data on SL.1.M.46 and SL.1.M.47 revealed that SL used information from the problem to match the results of the solutions obtained. In addition, SL made observations on the length and width obtained by comparing them and recalculated the circumference using the length and width that had been obtained. Thus, it was concluded that SL checked the results of the work. In addition, the SL.1.M.21, SL.1.M.22 and SL.1.M.23 data indicated that SL made plans that would be used in solving the problems at hand. Based on this, it can be concluded that SL had a plan in completing mathematical tasks. Even SL could arrange/make a good plan, the results of observations showed that SL had difficulty in compiling a settlement plan. This is indicated by the results of observation showing that SL did not immediately work on the questions after writing down all the information from the questions. SL read over and over again, tried to understand, and looked for a formula as an appropriate first step to solve the problem. The data on SL.1.M.24 and SL.2.M.27 showed that SL convinced himself to be successful in solving the rectangular problem. Therefore, it can be concluded that SL had confidence in planning and completing mathematical problem-solving tasks.

In the Strength dimension, the results of interview data on SL1.S.19, SL.1.S.34, SL.1.S.20 and SL's written answers indicated that SL had a high enthusiasm for solving the problems given. This means that SL had independence and an attitude of readiness to solve math problems faced. Thus it can be concluded that SL had a commitment to complete mathematical problem solving tasks. Data for SL.1.S.4, SL.1.S.5 and SL.1.S.6, SL.1.S.7 indicated that SL had prior knowledge regarding the problems at hand. Therefore, it can be concluded that SL had readiness in completing mathematical problem solving tasks. The data for SL.1.S.31, SL.1.S.32, and SL.1.S.33 showed that SL had previous experience in solving mathematical problems. Therefore, it can be concluded that SL had experience that could support solving mathematical problem solving tasks (See **Table 3**). In the dimension of generality, interview data on SL.1.G.14, SL.1.G.17, SL.1.G.21, and SL.1.G.22 indicated that SL knew the materials to be used in solving the questions. SL would also use the formula for circumference, area, multiplication operation, addition operation, and substitution in solving problems. In addition, data SL.1.G.53, SL.1.G.54, SL.1.G.55, SL.1.G.56, and SL.1.G.57 showed that SL knew the used concepts in solving problems, namely comparison, division, algebraic addition, and multiplication. This means that SL had initial thoughts regarding the steps and concepts used in solving mathematical problems. Thus, it can be concluded that SL had mathematical ideas used in solving mathematical problem tasks.

Interview data on SL.1.G.18, SL.1.G.28, SL.1.G.45, and SL.1.G.46 indicated that SL had confidence in all the information obtained. SL stated that the methods and ideas used were in accordance with the information in the questions. SL also had confidence in the correctness of the settlement results found from the steps taken. This proves that SL believed in the methods and designs prepared previously to solve the problems at hand. This shows that SL had confidence in mathematical ideas used in solving mathematical problem tasks. Data SL.1.G.58, SL.1.G.59, SL.1.G.60, SL.1.G.61, and SL.1.G.62 showed that SL believed in his ability to solve mathematical problems similar to the problem at hand. SL was confident in his ability to solve problems because he had experience in solving similar problems. In addition, SL also believed that he was able to solve problems different from the questions given. SL stated that when the questions given were different and still had a relationship with the problems at hand, then SL resolved them with the experience he had. In addition, SL also provided an overview of problems solved previously, such as rectangular and story questions. This means that SL guaranteed his ability to solve similar and different problems. Therefore, it can be concluded that SL had confidence in its ability to complete mathematical problem tasks with similar or different contexts (See **Table 4** and **Table 5**).

Table 3. The results of the analysis

TPMM1	TPMM2
The data (SL.1.M.9, SL.1.M.10, SL.1.M.11) showed that SL understood the problems faced, including the category of easy questions.	The data (SL.2.M.8, SL.2.M.9, SL.2.M.10, SL.2.M.11) showed that SL had knowledge related to the questions given.
The data (SL.1.M.29, SL.1.M.37, SL.1.M.40) showed that SL knew the level of difficulty of the questions given.	The data (SL.2.M.32 and SL.2.M.33) showed that SL did not find it difficult to understand the information on the questions. However, the data (SL.2.M.43 and SL.2.M.44) showed that SL had a little difficulty in solving the problems given when making mathematical models.
The data (SL.1.M.19, SL.1.M.49) showed that SL had confidence in himself to solve problems similar to the questions given.	The datum (SL.2.M.22) showed that SL had confidence in being able to solve the given problem because he already understood well all the information and had an overview of the solution to the given problem.
The answer written in (SL.1.M.38) showed that SL used all the information from the problem to solve the given mathematical problem.	The data (SL.2.M.14 and SL.2.M.15) showed that SL knew all the information on the questions given and believed the information interpreted was correct.
The datum (SL.1.M.46) showed that SL checked the written information and the problem solving steps taken.	The data (SL.2.M.53 and SL.2.M.54) illustrated that SL checked the results that had been done by rereading the questions, then matching the information known and asked in the questions, and checking each step taken and

TPMM1	TPMM2
	performed, including the calculation operations.
The data (SL.1.M.21 and SL.1.M.22) showed that SL used the formulas for circumference, area, multiplication, and addition, as well as substitution methods in solving the given problem.	Interview data (SL.2.M.24, SL.2.M.25, SL.2.M.26) showed that SL knew the material related to the problem by thinking about the solution method that would be used.
The datum (SL.1.M.24) showed that SL had confidence in the accuracy of the method used in solving the problem.	The datum (SL.2.M.27) showed that SL believed in the success of the plan that would be used because they already knew the information from the questions.

Table 4. The results of the analysis

TPMM1	TPMM2
The data (SL1.S.19 and SL.1.S.34) showed that SL had a high enthusiasm for solving new problems given. In addition, the datum (SL1.S.S20) also showed that SL had a commitment to solving the new problems given.	The data (SL.2.S.22 and SL.2.S.23) showed that SL had a commitment to solving new problems similar to the questions given. Reinforced again by datum (SL.2.S.40) showing that SL was willing to solve the new problems given, describing that he liked solving math problems.
The data (SL.1.S.4, SL.1.S.5, SL.1.S.6, SL.1.S.7) showed that SL understood the information from the questions given to solve the problems.	Interview data (SL.2.S.4, SL.2.S.5, SL.2.S.6) showed that SL knew the meaning of the information in the questions given. SL understood the terms in the questions and then translated them into mathematical language.
The data (SL.1.S.31 and SL.1.S.32) showed that SL had ever solved problems similar to the questions given. It provided an overview of the problems that had been solved before.	The data (SL.2.S.35 and SL.2.S.36) showed that SL had experience on solving problems similar to the questions given. SL told about problems that had been solved before, namely story questions related to rectangles like the questions given, but with different completion goals.

Table 5. The results of the analysis

TPMM1	TPMM2
The data (SL.1.G.14, SL.1.G.17, SL.1.G.21, SL.1.G.22) showed that SL had an idea of all the information contained in the questions. SL explained the material and the method used in solving the problem.	The data (SL.2.G.13 and SL.2.G.16) showed that SL knew the material used in solving the given problem.
The data (SL.1.G.18 and SL.1.G.28) showed that SL had confidence in the ideas used in solving the problems given.	The data (SL.2.G.21 and SL.2.G.31) showed that SL believed in the accuracy of his answer based on all the information he obtained.
The data (SL.1.G.58 and SL.1.G.59) showed that SL believed in his ability to solve mathematical problems similar to the questions given.	Interview data (SL.2.G.69 and SL.2.G.71) showed that SL believed in his ability to solve problems, based on his experience in solving the questions given. This information shows that SL used the method he ever utilized to solve the given problem.

Data explanation of female subjects (SP)

In the dimension of magnitude, interview data SP.1.M.14, SP.1.M.15 and written answers from SP indicated that SP had an initial picture of the problem given. Therefore, it can be concluded that SP had knowledge related to the level of difficulty of mathematical tasks. Data from interviews in SP.1.M.19, SP.1.M.66, and SP.1.M.67 showed that SP found it difficult to solve the problems given, even she has an easy understanding of the information from the questions. Therefore, it was concluded that SP had difficulty in completing mathematical tasks in certain sections. Data SP.1.M.44, SP.1.M.45, and SP.1.M.54 showed that SP used her knowledge of the problems presented to solve similar problems. Thus, it can be concluded that SP had confidence in being able to successfully complete mathematical tasks.

Interview data on SP.1.M.72 and written answers showed that SP used information on the questions to achieve the objectives of the questions. Based on these activities, it can be concluded that SP could use all the information to complete mathematical tasks. SP.1.M.91, and SP.1.M.92 data showed that SP had strong confidence in the results of her work, even she did not re-check. Interview data on SP.1.M.36, SP.1.M.41, SP.1.M.44, SP.1.M.46, and SP.1.M.48 indicated that SP had a plan that would be used to solve the problem at hand. Therefore, it can be concluded that SP had a plan in completing mathematical tasks. Furthermore, interview data on SP.1.M.42 showed that SP had confidence about her success in solving rectangular problem. This shows that SP had confidence in planning and completing mathematical tasks. The results of the analysis are shown in **Table 6**.

In the Strength dimension, interview data SP.1.S.22, SP.1.S.32, SP.1.S.68 and written answers from SP indicated that SP had an enthusiastic attitude and high commitment to solving math problems faced. Therefore, it can be concluded that SP had a commitment to complete mathematical tasks. Interview data on SP.1.S.7, SP.1.S.8, SP.1.S.9, SP.1.S.11, SP.1.S.12, SP.1.S.27 , SP.1.S.28, SP.1.S.29, and SP.1.S.30 indicated that the SP had an overview of prior knowledge regarding the problems encountered. This shows that SP had readiness in completing mathematical tasks. Interview data SP.1.S.57, SP.1.S.59, SP.1.S.62, SP.1.S.63, and SP.1.S.64 indicated that SP had previous experience in completing math problem. Therefore, it can be concluded that SP had experience supporting her to complete mathematical tasks. The results of the analysis are shown in **Table 7**.

Table 6. The results of the analysis

TPMM1	TPMM2
SP understood the problem at hand, including moderate category question.	SP understood the problem at hand, including moderate category question.
SP knew the difficulty level of the questions given.	SP could state the difficulty level of the questions given.
SP reasoned that the information contained in the questions could provide an overview of the problem solving.	SP reasoned that the information contained in the questions could provide an overview of the problem solving.
SP used all the information from the question to solve the given math problem.	SP used all the information from the problem to solve a given math problem. In addition, the SP described all the completion steps carried out. In addition, SP also believed in her ability to examine all the information on the question to solve problems
SP did not check the written information and problem solving steps taken.	SP did not check the results of the work done. SP felt confident about the accuracy of her work.
SP used the circumference and area formulas in solving the given problem.	SP used the formula for the circumference and area of a rectangle in solving problems.
SP had confidence in the success of the methods used in solving problems.	SP had confidence in the success of the methods used in solving problems.

Table 7. The results of the analysis

TPMM1	TPMM2
SP had a high enthusiasm for solving similar problems given. In addition, SP data showed that SP had a commitment to solving new problems given.	SP had a high enthusiasm and commitment to solving similar problems.
SP understood the information from the questions given, so she was sure that she could solve the questions given.	SP understood the information from the questions given and she believed that she was able to solve the questions given. She explained all the information representing a rectangular geometry. In addition, SP was confident that she understood all the information provided.
SP once solved problems similar to the questions given, namely rectangles and story questions. She explained the general picture of the problems she solved before. In addition, SP also felt that she was able to solve the new questions given.	SP had never solved a problem similar to the given question. However, SP had solved problems related to rectangles and story problems. In addition, she provided an overview of the problems solved before.

For the generality dimension, interview data on SP.1.G.36, SP.1.G.37, SL.1.G.21, SL.1.G.22 and SP's written answers showed that SP had an initial planning regarding information, methods of completion, as well as the concepts used in solving mathematical problems. Therefore, it can be concluded that SP had mathematical ideas used in completing mathematical tasks in the form of concepts. Interview data SP.1.G.39, SP.1.G.40, SP.1.G.73, SP.1.G.74, and SP.1.G.75 showed that SP had high confidence in mathematical ideas used in solving math tasks. Interview data SP.1.G.106, SP.1.G.107, and SP.1.G.108 showed that SP guaranteed her ability to solve similar and different problems. Therefore, it can be concluded that SP had confidence in her ability to complete mathematical tasks with similar or different contexts. The results of the analysis are shown in **Table 8**.

Table 8. The results of the analysis

TPMM1	TPMM2
SP had knowledge related to information on the questions. He explained the material used in solving the problem and the method used. SP also explained the mathematical form of the problem, found length and width of geometry, found area of geometry, and explained how to use the circumference formula.	SP had knowledge related to information on the questions. SP explained the material used in solving problems, namely the formula for the circumference and the formula for the area of a rectangle. SP also explained how to find area, find length and width, and explained how to use the circumference formula.
SP had confidence in the ideas used in solving the problems given.	SP had confidence in the materials, ideas, and concepts used in solving the given problems, and believed in ideas and ways to get the length and width.
SP believed in her ability to solve mathematical problems similar to the given problem.	SP believed in her ability to solve mathematical problems similar to the given problem.

4.2 Discussion

Students' self-efficacy based on magnitude

Male student was confident in his ability to solve the problems at hand, he thought that the difficulty of problem was in line with their thinking. In a sense, self-efficacy on the dimension of magnitude, a person would be faced with problems or tasks according to a certain level of difficulty. Therefore, a person's self-efficacy will be limited to easy, moderate, and difficult tasks according to the perceived ability limit to meet the behavioral demand required at each of these levels (Bandura, 2010; Kim et al., 2013; Liu et al., 2008). Furthermore, if someone gets into a problem, he will try to solve the problem he is facing. This is in line with the statement put forward by Edman & Brazil (2009), that culture is correlated with one's self-efficacy in academic terms.

In addition, male student had confidence that he was successful in completing a math task. He felt he was able to solve the problems given because he already knew the formulas, solutions, and calculation operations used in new problems. This indicates the competence of the student in solving similar problem. Actions based on firm belief about success will play a major role in solving mathematical problems. This spirit is a motivation to act that comes from inner voice of a person (Ramdass & Zimmerman, 2008). Therefore, male student had the ability to parse and provide solutions to the problems he faced. In contrast to male student, female student had moderate self-efficacy towards math tasks, namely stating the level of difficulty of the problems faced was classified as "medium". Female student had the ability to compare the level of difficulty of the questions with her knowledge. In addition, some of the information on the questions that were still in the form of contextual terms could be well understood and expressed in mathematical form. Therefore, female subject had prior knowledge of the given problem. The activity of female student showed that the student had knowledge related to the level of difficulty of math tasks. In self-efficacy assessment on the magnitude dimension, a person was faced with problems or tasks arranged according to a certain level of difficulty. Therefore, a person's self-efficacy will be limited to easy, moderate, and difficult tasks according to the perceived ability limit (Hill, 2010; Yurekli et al., 2020).

In this dimension, female subject also had self-efficacy, namely confidence in herself in completing mathematical tasks. She stated that she could solve the given problem. This is based on the information contained in the question, where the student was able to provide an overview of problem solving. In this case, female student used her knowledge of the questions presented to solve problems. Furthermore, female student had a plan in completing math tasks. With the initial knowledge possessed by the female student, she was able to organize the formulas used to solve problems, namely the formula for the circumference and area of a rectangle. This is in line with the finding of Kim et al., (2013), stating that someone who has self-efficacy can control his/her feelings, thoughts, and actions. Self-efficacy in this case is the planning of completing mathematical tasks. Finally, female student had confidence in the planning of completing math tasks. SP confidence referred to the information obtained on the question, which was in accordance with the plan she had.

Students' self-efficacy based on strength dimension

The activity of male student in solving mathematical problems on the strength dimension was indicated by his commitment to solving mathematical problem tasks. As for some of the activities carried out, namely having a high enthusiasm for solving similar problems given, being willing and stating that he was able to solve new problems given based on experience working on the problems at hand. Male student needed to focus his concentration when he was given a new math problem tasks. This means that SL had independence and an attitude of readiness to solve mathematical problems faced. In this case, the dimension of strength in individuals was indicated by the stability of a person's heart or the level of belief in a person's ability to complete tasks (Gunderson et al., 2012; Ndlovu et al., 2020). Furthermore, male student had readiness in completing math tasks. In this case, male student understood the information from the given problem and knew the meaning of the information on the problem and translated it into mathematical language. In addition, he also knew the material used in solving the given problem and believed in the accuracy of the information written and explained from the problem. This means that male student had prior knowledge of the problems at hand. Male student had experience supporting him in completing math assignments. He stated that he had experience in solving problems similar to the questions given, in the form of story questions related to rectangles such as the problems at hand. In other words, someone able to do something or has success experience in the past will experience increased self-efficacy in carrying out these activities (Groth et al., 2018; Guo et al., 2015).

Furthermore, female student on this dimension indicated that she had a commitment to solving mathematical problem tasks. In solving similar problems given, female student had a high enthusiastic attitude. She expressed her readiness and felt confident in her ability to solve the new problems given based on experience working on the problems at hand. On the other hand, the female student stated that she needed a long time to be able to solve the new problem. This shows that in this dimension the individual has a strong belief in her ability to complete tasks (Bong & Skaalvik, 2003; Cecil & Pinkerton, 2000). In addition, female student had readiness in completing mathematical problem solving tasks. Female subject had an understanding of the information from the questions given, in this case the representation of a rectangular geometry. She stated and believed that the information written and explained from the question was correct. This means that female student had prior knowledge in solving the problems at hand. This is in line with the finding of (Usher, 2009; Williams & Williams, 2021) stating that individuals have strength which refers to assertiveness and confidence in doing something with their abilities. Furthermore, the level of self-efficacy possessed by experienced female student would support her in completing math tasks. The female student stated that she had solved a problem similar to the one given, then she explained that the question in question was a rectangular question and a story problem. In addition, she had the readiness to solve problems if given a new question. In other words, female student had previous experience in solving math problems. Thus, past experiences can affect a person's self-efficacy in the form of success and failure (Lee et al., 2019; Renninger et al., 2011; Yurekli et al., 2020).

Students' self-efficacy based on the generality dimension

There was solving problem activity that male student did on the dimension of generality, namely making comparison of length and width in accordance with the information on the problem. In this case, male student used the formula for the circumference, area, multiplication operations, addition operations, and substitutions in solving problems. In addition, male student also stated the concepts used in solving problems, namely comparison, division, algebraic addition, and multiplication. In this case, male student had initial thoughts or ideas related to ways and concepts used in solving mathematical problems. The initial knowledge of mathematical concepts and ideas possessed by male student was one of the success factors in completing math tasks. The activities carried out by male student are relevant to the findings of previous studies (Bandura, 2010; Kholid et al., 2020; Ndlovu et al., 2020). Furthermore, male student had confidence in the ideas used in solving mathematical problem tasks. He convinced himself that all the information he got was correct, then the steps, the ideas or concepts he took and used, and the results of problem solving were in accordance with the purpose of the problem. This shows that male student was confident in the ways and designs of thinking prepared previously to solve the problems at hand.

Self-efficacy in female student having mathematical ideas played a role in solving mathematical problem tasks. Female student who understood the information in the problem would solve mathematical problems by using mathematical forms/models, by finding length and width, by finding area, and by using the circumference formula. In addition, female student also applied mathematical concepts in solving problems, such as dividing both sides, algebraic addition operations, addition of fractions, and multiplication of integers. In this case, female student had initial ideas and concepts used in solving mathematical problems. In self-efficacy theory, the activities carried out by female student are relevant to previous findings (Bandura, 2010; Moores et al., 2006; Suzuki, 2013) saying that the generality dimension is related to the breadth of the task carried out by a person. Furthermore, female student on the generality dimension showed confidence and ability in completing mathematical problem tasks. She had confidence that all the information she got and the results of problem solving were correct. In this case, female student believed in the methods used and the prior knowledge prepared to solve the problems she faced. In other words, someone who has self-confidence based on peace of mind and wisdom in solving problems will feel calm, peaceful and happy (Williams & Williams, 2021; Yurekli et al., 2020). Finally, female student had confidence in her ability to complete mathematical tasks in similar or different contexts. She believed that she was able to solve the mathematical problems she was facing because she had experience working on similar problems. This was shown by the statement of the female student saying that the questions given were not too difficult, so she was able to solve the problems based on her experience. However, if the question was difficult, female student could not solve it correctly according to the purpose of the question. This means that female student was able to guarantee her ability to solve similar problems. This shows that someone who has self-efficacy can control his/her feelings, thoughts, and actions. Faith followed by passion; actions based on firm belief about success will stimulate the emergence of high morale (Ebony O. McGee, 2015; Goulet-Lyle et al., 2020; Gunderson et al., 2012).

5. CONCLUSION

The question in this study is how is the student's self-efficacy profile in solving problems based on gender? We highlight three dimensions of self-efficacy: magnitude, strength, and generality. First, the magnitude dimension: male student expressed all the information known and asked about, the purpose/objective of the problem, then considered the mathematical task he faced could be solved well on the grounds that it was easy to understand the language used, so that male student could clearly understand the information contained in the question. Although he considered the questions easy, male student had difficulty in making mathematical models. In completing math tasks, male student had confidence that he would successfully complete math tasks, use all the information to complete math assignments, and check the results of the work. In addition, male student had careful planning in completing math tasks and had confidence in his ability to complete math tasks according to plan.

Dimensions of strength: In solving math problems, male student's self-efficacy included commitment (diligent/independent/enthusiastic), readiness to solve problems, and supportive experiences. Male student had an enthusiastic attitude to solve similar problems given and he felt that he could solve the problems given based on experience working on the problems at hand. In completing math tasks, male student had prior knowledge related to the problems at hand. In addition, the male student had previous experience in solving math problems. The experience became a strong factor so that he was able to solve the problems given. Generality dimension: male student's self-efficacy in solving math problems included the mathematical ideas used and confidence in his abilities. In solving mathematical problems, male student had initial thoughts or ideas related to solutions and concepts used in solving mathematical problems and was able to believe in ways and designs prepared previously to solve the problems at hand. In addition, male student had confidence and able to guarantee his ability to complete mathematical tasks in similar or different contexts. Confidence in one's abilities was based on experience in solving the given problems. Second, for female student on the dimension of magnitude: In solving math problems, female student had views on math problems. In view of math problems, female student had prior knowledge of the given problem and able to describe the level of difficulty of math tasks at a moderate level. In addition, female student had difficulty in solving mathematical transformation problems. In completing the math task, the female student had confidence that she could successfully complete the math task and used all the information to complete the math task, but she did not check the results of the work. In terms of the planning of completing math tasks, female student had careful planning in completing math tasks and had confidence in the planning for completing math tasks.

Dimension of strength: female student's self-efficacy in solving math problems included commitment (diligent/independent/enthusiastic), readiness to solve problems, and supportive experiences. Female student had a high enthusiasm for solving similar problems given and able to solve new problems given based on experience working on the problems at hand. However, it took long time to be able to solve new problems. In completing mathematics tasks, female student had prior knowledge of the problems at hand used in solving problems. In addition, female student had previous experience in solving math problems. The generality dimension: female student's self-efficacy in solving math problems included the mathematical ideas used and the belief in her abilities. In solving math problems, female student had initial ideas and concepts used to solve math problems. Female student also believed in the methods and prior knowledge prepared in advance to solve the problems she faced. In addition, female student had confidence and able to guarantee her ability to complete mathematical tasks in similar or different contexts. Confidence in her abilities based on experience would help female student solved the problems given.

RECOMMENDATIONS AND LIMITATIONS

The study findings show that students had high self-efficacy in solving math problems if the problems given involved contextual math problems (the daily life of Bugis people). Therefore, further researchers need to study more about students' self-efficacy in solving contextual problems in a wider scope. Furthermore, this study also showed a relevant relationship between the dimensions of self-efficacy and cultural characteristics. Therefore, further researchers need to study further the relationship between self-efficacy and Bugis culture. One of the limitations of this research is that it only involved male subject of Bugis ethnicity and female subject of Bugis ethnicity. Therefore, the research would be better if it was expanded to involve subjects from other ethnics such as Makassar ethnics, Toraja ethnics, and Mandar ethnics. Thus, the results of the research obtained are complete as consideration for the development of a theory of self-efficacy based on ethnicity and gender.

AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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SURAT KEPUTUSAN
DEKAN FKIP UNIVERSITAS ISLAM RIAU

Nomor : 0983 /FKIP-UIR/Kpts/2022

Tentang : Penunjukan Pembimbing I dan Pembimbing II Penulisan Skripsi Mahasiswa FKIP UNIVERSITAS ISLAM RIAU

Menimbang : 1. Bahwa untuk membantu mahasiswa dalam penyusunan skripsi, maka perlu ditunjuk pembimbing I dan II yang akan memberikan bimbingan sepenuhnya terhadap mahasiswa tersebut.
2. Bahwa saudara-saudara yang namanya tersebut tercantum dalam Surat Keputusan ini dipandang mampu dan memenuhi syarat untuk membimbing skripsi mahasiswa, maka untuk itu perlu ditetapkan dengan Surat Keputusan Dekan.

Mengingat : 1. Undang-undang nomor 20 tahun 2003 tentang sistem pendidikan nasional.
2. Undang-undang nomor 12 tahun 2012 tentang pendidikan tinggi.
3. Peraturan pemerintah nomor 19 tahun 2005 tentang standar nasional pendidikan tinggi.
4. Surat Keputusan menteri pendidikan nasional :
   a. Nomor 339/U/1994 tentang ketentuan pokok penyelenggaraan perguruan tinggi.
   b. Nomor 224/U/1995 tentang badan akreditasi nasional perguruan tinggi.
   c. Nomor 232/U/2000 tentang pedoman kurikulum pendidikan tinggi dan penilaian hasil belajar Mahasiswa.
   d. Nomor 124/U/2001 tentang pedoman pengawasan, pengendalian, dan pembinaan program studi perguruan tinggi.
   e. Nomor 045/U/2002 tentang kurikulum inti pendidikan tinggi.
5. Surat Keputusan pimpinan YLPI Riau nomor 66/Kep/YLPI-II/1976 tentang peraturan dasar Universitas Islam Riau.
6. Surat Keputusan Rektor Universitas Islam Riau nomor. 112/UIR/Kpts/2016 tentang pengangkatan Dekan FKIP Universitas Islam Riau tanggal.31 Maret 2016.

MEMUTUSKAN

Menetapkan : 1. Menunjuk nama-nama tersebut dibawah ini sebagai pembimbing skripsi

No.	Nama	Pangkat/Golongan	Pembimbing
1.	Dr. Dedek Andrian, S.Pd., M.Pd.	Lektor - Penata/ III/c	Pembimbing Utama
2.			Pembimbing Pendamping

Nama Mahasiswa	Nurfajar Wahyuliana
NPM .	186410252
Program Studi	Pendidikan Matematika
Judul Skripsi	**Pengembangan Media Pembelajaran Segitiga Berbasis Adobe Animate CC Dengan Desain Pembelajaran ADDIE.**

2. Tugas-tugas pembimbing berpedoman kepada ketentuan yang berlaku.
3. Dalam melaksanakan bimbingan, pembimbing supaya memperhatikan usul dan saran seminar proposal
4. Kepada Saudara yang namanya tercantum dalam lampiran Surat Keputusan ini diberi honorarium sesuai dengan ketentuan yang berlaku di Universitas Islam Riau.
5. Surat Keputusan ini mulai berlaku sejak surat keputusan ini diterbitkan, dengan ketentuan apabila terdapat kekeliruan akan diadakan perbaikan sebagaimana mestinya.

Kutipan : Disampaikan pada yang bersangkutan untuk dapat dilaksanakan sebaik-baiknya.

Ditetapkan : di Pekanbaru
Tanggal : 18 Agustus 2022
Plt Dekan,

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PEKANBARU
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN

Dr. Miranti Eka Putri, S.Pd.,M.Ed.
NPK. 091102367

Tembusan disampaikan kepada :
1. Yth.Rektor UIR Pekanbaru
2. Yth.Kepala Biro Keuangan UIR Pekanbaru
3. Yth.Ketua Program Studi **Pendidikan Matematika** FKIP UIR Pekanbaru
4. Pertinggal..

SURAT KETERANGAN PERJANJIAN

Saya yang bertanda tangan di bawah ini:

PIHAK 1 Nama Dosen : Dr. Dedek Andrian, S.Pd., M.Pd.

NIDN : 1006128803

Uni Kerja : Pendidikan Matematika FKIP UIR

Menerangkan bahwa :

PIHAK 2 Nama Mahasiswa : Nurfajar Wahyuliana

NPM : 186410252

No HP : 082188164316

Memilih jalur 'Publikasi Ilmiah di Jurnal terakreditas sinta 1 atau sinta 2 untuk nilai A dan sinta 3 untuk nilai B sesuai dengan Peraturan Rektor Nomer : 015/UIR/PR/2018' untuk menyelesaikan studi sarjana (S1) Pendidikan Matematika.

Melalui surat keterangan perjanjian ini, Pihak 1 sebagai Dosen Pembimbing dan Pihak 2 sebagai Mahasiswa Bimbingan menyatakan bahwa benar-benar **berkomitmen** dalam memilih jalur tersebut hingga artikel terbit pada Jurnal yang disebutkan diatas.

Demikian surat keterangan perjanjian ini dibuat atas permohonan Pihak 1 dan Pihak 2.

Pekanbaru, 12 Desember 2022

Mahasiswa

METERAI TEMPEL 160AKX180482213

Nurfajar Wahyuliana

NPM 186410252

Dosen Pembimbing

METERAI TEMPEL 27725AKX180482223

Dr. Dedek Andrian, S.Pd., M.Pd

1006128803

Mengetahui,

Dekan FKIP

Dr. Miranti Eka Putri, S.Pd., M.Ed

NIDN 1005068201

Ketua Program Studi

Rezi Ariawan, S.Pd., M.Pd

NIDN 1014058701

UNIVERSITAS ISLAM RIAU
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
الجامعة الإسلامية الرياوية
Alamat: Jalan Kaharuddin Nasution No. 113, Marpoyan, Pekanbaru, Riau, Indonesia - 28284
Telp. +62 761 674674 Fax. +62761 674834 Email: edufac.fkip@uir.ac.id Website: www.uir.ac.id

BERITA ACARA KELULUSAN/ JALUR JURNAL

Berdasarkan Surat Keputusan Dekan Fakultas Keguruan dan Ilmu Pendidikan Universitas Islam Riau Tanggal 30 bulan Desember, tahun 2022 Nomor : ...... /Kpts-FKIP/2022 dengan merujuk pada Peraturan Rektor Universitas Islam Riau Nomor: 015/UIR/PR/2018 Pasal 3, tentang Pelaksanaan Ujian Tugas Akhir pada Jenjang Pendidikan Sarjana dan Magister di Lingkungan Universitas Islam Riau melalui Jalur Jurnal Nasional Terakreditasi minimal Sinta 3. Maka pada hari Jumat, tanggal 30, tahun 2022 telah dipublikasikan artikel ilmiah atas nama mahasiswa berikut ini:

Nama	: Nurfajar Wahyuliana
Nomor Pokok Mahasiswa	: 186410252
Program Studi	: Pendidikan Matematika
Judul Artikel	: Deveopment of Triangular Learning Media Based on Adobe Animate CC with ADDIE Learning Design
Tanggal Publish	: 30 Desember 2022
Nama Jurnal	: International Journal of Trends in Mathematics Education Research
Volume, Nomor, Bulan, Tahun	: 5 (4) 2022, pp 335-342
Alamat Web	: https //doi.org/10.33122/ijtmer v5i4 146
Terindeks	: Google Schoolar, Sinta 3
Nilai Publikasi Artikel	: B

Pekanbaru, 30 Desember 2022

Ketua Program Studi

(Rezi Ariawan, M.Pd)

Pembimbing

(Dr. Dedek Andrian, M.Pd)

Mengetahui,
Dekan FKIP UIR

Dr. Miranti Eka Putri, S.Pd., M.Ed.
NIP/NPK : 09 11 02 367
NIDN. 1005068201

Lembar Validasi Ahli Materi

Lembar Kerja Peserta Didik (LKPD) Matematika Berbantuan *Winplot*

Judul Penelitian : Pengembangan Lembar Kerja Peserta Didik (LKPD) Matematika Berbantuan Winplot Pada Materi Fungsi Kuadrat Kelas IX SMP

Peneliti/pengembang : Irma Juliandiska

Pembimbing : Sari Herlina, S. Pd., M. Pd

Dengan Hormat,

Sehubungan dengan adanya Lembar Kerja Peserta Didik (LKPD) matematika berbantuan *winplot*, maka melalui instrument ini Bapak/Ibu kami mohon untuk memberikan penilaian terhadap LKPD yang dibuat. Penilaian dari Bapak/Ibu akan digunakan sebagai validasi dan masukan untuk memperbaiki dan meningkatkan kualitas LKPD, sehingga bisa diketahui layak atau tidaknya LKPD tersebut digunakan dalam pembelajaran matematika.

A. Petunjuk Pengisian Angket

1) Bapak/Ibu dimohon untuk memberikan tanda *check* (✓) pada kolom skor penilaian yang tersedia. Adapun deskripsi skala penilaian adalah sebagai berikut:

   1 = Tidak Baik/ Tidak Sesuai
   3 = Baik/ Sesuai
   2 = Kurang Baik/ Kurang Sesuai
   4 = Sangat Baik/ Sangat Sesuai

2) Apabila terdapat saran silahkan isi pada kolom paling kanan. Jika ada komentar silahkan isi pada kolom paling akhir yang tersedia

3) Terimakasih atas kesediaan Bapak/Ibu untuk mengisi validasi ini

Nama :

NIDN/NIP :

B. Penilaian

No	Kriteria Penilaian	LKPD-1				LKPD-2				LKPD-3				LKPD-4			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
A. Kelayakan Materi/ Isi																	
1	Kelengkapan materi pada LKPD ditinjau dari Kompetensi Dasar (KD) dan Kompetensi Inti (KI)																
2	Keluasaan materi pada LKPD ditinjau dari KD																
3	Kedalaman materi pada LKPD ditinjau dari KD																
4	Kesesuaian LKPD dengan perkembangan peserta didik																
5	Indikator Pencapaian Kompetensi (IPK) pada LKPD sesuai dengan KD																
6	Tujuan pembelajaran sesuai dengan materi fungsi kuadrat pada LKPD																
7	Keakuratan dan ketepatan konsep pada LKPD																
8	Keakuratan masalah-masalah dan contoh yang diberikan pada LKPD																
9	Keakuratan soal-soal yang disajikan pada materi di dalam LKPD																
10	Ketepatan penggunaan istilah-istilah pada LKPD																
11	Materi pada LKPD sesuai dengan Indikator Pencapaian Kompetensi (IPK)																
12	Materi pada LKPD disajikan terstruktur																
B. Didaktik																	
13	LKPD dirancang sesuai dengan Standar Kompetensi (SK) dan Kompetensi Dasar (KD)																
14	LKPD memfasilitasi peserta didik untuk																

No	Kriteria Penilaian	LKPD-1				LKPD-2				LKPD-3				LKPD-4			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	mengidentifikasi masalah																
15	LKPD menfasilitasi peserta didik untuk menarik kesimpulan																
16	LKPD yang dikembangkan dapat digunakan untuk mengidentifikasi masalah fungsi kuadrat																
17	LKPD membimbing peserta didik untuk menentukan konsep fungsi kuadrat																
C. Kesesuaian Penyajian																	
18	Kesesuaian indikator dan tujuan pembelajaran pada LKPD																
19	Penyajian materi pada LKPD sistematis																
20	Keruntutan konsep pada LKPD																
21	Kelengkapan informasi materi pada LKPD																
22	Ketersedian contoh dan latihan soal dalam setiap kegiatan pembelajaran pada LKPD																
23	Ketersedian kesimpulan pada LKPD																
D. Kesesuaian LKPD Berbantuan *Winplot*																	
24	Penggunaan *software winplot* sesuai dengan materi yang disajikan																
25	Keakuratan grafik fungsi pada *software winplot* sesuai dengan fungsi kuadrat																
26	Keakuratan gambar, grafik, dan ilustrasi pada LKPD dengan menggunakan *software winplot*																
27	Grafik fungsi yang direpresentasikan oleh *software winplot* memudahkan memahami materi fungsi kuadrat																
28	Permasalahan yang digunakan mendukung penggunaan *software winplot*																

No	Kriteria Penilaian	LKPD-1				LKPD-2				LKPD-3				LKPD-4			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
E. Bahasa																	
29	Ketepatan kalimat yang digunakan pada LKPD																
30	Kalimat-kalimat pada LKPD tidak menimbulkan makna ganda																
31	Bahasa yang digunakan sesuai dengan perkembangan intelektual peserta didik																
32	Ketepatan ejaan yang digunakan (EYD)																
33	Pertanyaan pada LKPD disusun dengan kalimat yang jelas dan pernyataan mudah dipahami																

C. Saran/Komentar

Kriteria Hasil Penilaian Validator :

1. Layak digunakan dengan revisi besar
2. Layak digunakan dengan revisi kecil
3. Tidak layak digunakan

Pekanbaru, 2022

Validator

....

NIDN.

Lembar Validasi Ahli Media

Lembar Kerja Peserta Didik (LKPD) Matematika Berbantuan *Winplot*

Judul Penelitian : Pengembangan Lembar Kerja Peserta Didik (LKPD) Matematika Berbantuan Winplot Pada Materi Fungsi Kuadrat Kelas IX SMP

Peneliti/pengembang : Irma Juliandiska

Pembimbing : Sari Herlina, S. Pd., M. Pd

Dengan Hormat,

Sehubungan dengan adanya Lembar Kerja Peserta Didik (LKPD) matematika berbantuan *winplot*, maka melalui instrument ini Bapak/Ibu kami mohon untuk memberikan penilaian terhadap LKPD yang dibuat. Penilaian dari Bapak/Ibu akan digunakan sebagai validasi dan masukan untuk memperbaiki dan meningkatkan kualitas LKPD, sehingga bisa diketahui layak atau tidaknya LKPD tersebut digunakan dalam pembelajaran matematika.

A. Petunjuk Pengisian Angket

1) Bapak/Ibu dimohon untuk memberikan tanda *check* (✓) pada kolom skor penilaian yang tersedia. Adapun deskripsi skala penilaian adalah sebagai berikut:

   1 = Tidak Baik/ Tidak Sesuai 3 = Baik/ Sesuai

   2 = Kurang Baik/ Kurang Sesuai 4 = Sangat Baik/ Sangat Sesuai

2) Apabila terdapat saran silahkan isi pada kolom paling kanan. Jika ada komentar silahkan isi pada kolom paling akhir yang tersedia

3) Terimakasih atas kesediaan Bapak/Ibu untuk me ngisi validasi ini

Nama :

NIDN/NIP :

B. Penilaian

No	Kriteria Penilaian	LKPD-1				LKPD-2				LKPD-3				LKPD-4			
		1	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
A. Ukuran																	
1	Ukuran tulisan pada LKPD bisa dibaca																
2	Ukuran gambar pada LKPD bisa dibaca																
3	Ukuran grafik fungsi kuadrat pada LKPD bisa dipahami																
B. Desain Cover																	
4	Desain cover menarik																
5	Desain cover mewakili materi																
C. Desaian Isi																	
6	Tampilan rumus matematika sesuai dengan materi fungsi kuadrat																
7	Penggunaan grafik fungsi sesuai dengan materi fungsi kuadrat																
8	Kesesuaian jenis dan ukuran huruf pada LKPD																
9	Kesesuaian grafik, gambar, dan ilustrasi pada LKPD																
D. Kesesuaian LKPD Berbantuan *Winplot*																	
10	*Software winplot* yang disajikan dapat mempermudah pemahaman konsep																
11	Tampilan grafik fungsi pada *software winplot* menarik																
12	Ukuran tulisan dan garis pada *software winplot* jelas																
13	Warna tulisan dan garis grafik pada *software winplot* menarik																
E. Kesesuaian Bahasa																	
14	Tata bahasa yang digunakan sesuai dengan																

No	Kriteria Penilaian	LKPD-1				LKPD-2				LKPD-3				LKPD-4			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	EYD																
15	Tanda baca yang digunakan sudah sesuai																
16	Kalimat yang digunakan mudah dipahami																
F.Waktu																	
17	Waktu yang diberikan untuk mengerjakan LKPD sudah cukup																
18	Waktu yang diberikan untuk penggunaan *software winplot* sudah cukup																

C. Saran/Komentar

Kriteria Hasil Penilaian Validator :

1. Layak digunakan dengan revisi besar
2. Layak digunakan dengan revisi kecil
3. Tidak layak digunakan

Pekanbaru, 2022

Validator

....

NIDN/NIP.

ANGKET KEPRAKTISAN TERHADAP MEDIA PEMBELAJARAN

Mata Pelajaran : **Matematika**

Materi : **Bangun Ruang Prisma**

Jenis Produk : **Media Pembelajaran *Macromedia Flash***

Judul Produk : **Pengembangan Media Pembelajaran *Macromedia Flash* Melalui Model Desain *Assure* Pada Pembelajaran Matematika Untuk Menumbuh Kembangkan Kemampuan Penalaran Matematis Siswa SMPN 1 Ujung Batu**

Nama Peneliti : **David Maclinton**

Nama Validator : **…………………………….**

Hari/Tanggal : **…………………………….**

A. PETUNJUK PENGGUNAAN

Dalam rangka pengembangan media pembelajaran *Macromedia Flash* di kelas, kami mohon kesediaan Bapak/Ibu memberikan tanggapan terhadap media pembelajaran *Macromedia Flash* pada materi prisma yang telah dikembangkan.

1. Lembar penilaian ini bertujuan untuk menilai kelayakan media pembelajaran berupa *Macromedia Flash* berdasarkan aspek kepraktisan.
2. Isilah jawaban pertanyaan dibawah ini sesuai dengan pendapat anda dengan menggunakan tanda (√) pada kolom yang tersedia.

SB : Sangat Setuju   KS : Kurang Setuju

S : Setuju   SKS : Sangat Kurang Setuju

B. PENILAIAN

No	Pernyataan	Pilihan Jawaban			
		SB	S	KS	SKS
1	Tampilan media pembelajaran *Macromedia Flash* menarik sehingga dapat membangkitkan minat dalam				

	proses belajar mengajar matematika				
2	Bahasa yang ditampilkan pada media pembelajaran *Macromedia Flash* mudah untuk dipahami dan dimengerti				
3	Isi media pembelajaran *Macromedia Flash* memenuhi aspek materi pelajaran, tujuan pembelajaran, Kompetensi inti dan Kompetensi dasar				
4	Media Pembelajaran *Macromedia Flash* mudah untuk diterapkan ke dalam materi pembelajaran				
5	Penggunaan media pembelajaran *Macromedia Flash* memudahkan guru dalam memberikan materi				
6	Waktu yang digunakan dalam penggunaan media pembelajaran *Macromedia Flash* efisien				
7	Media Pembelajaran *Macromedia Flash* melalui model desain *Assure* memudahkan guru dalam memberikan visual pembelajaran sehingga murid bisa membayangkan materi pembelajaran				
8	Media Pembelajaran *Macromedia Flash* melalui model desain *Assure* membantu guru mengaitkan materi pelajaran sesuai dengan kehidupan sehari – hari peserta didik				

Komentar dan saran perbaikan

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Pekanbaru,…………………2021

Guru

(………………………)

UNIVERSITAS ISLAM RIAU
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN
PROGRAM STUDI PENDIDIKAN MATEMATIKA
Jalan KaharuddinNasution No. 113 P. MarpoyanPekanbaru Riau Indonesia – Kode Pos: 28284
Telp. +62 761 674674 Fax. +62 761 674834 *Website*: www.uir.ac.id*Email*: info@uir.ac.id

SURAT TUGAS VALIDATOR

Nomor: 104/A-UIR/7-PMAT/2022

Berdasarkan surat permohonan Dosen Validator yang ditujukan kepada Ketua Program Studi, Maka Kami Menugaskan Bapak/Ibu:

Nama	: Dr. Indah Widiati, M.Pd
NIDN/NIP	: 1021058702
Fungsional/Golongan	: Asisten Ahli/IIIb
Pekerjaan	: Dosen Pendidikan Matematika
Unit Kerja	: Universitas Islam Riau

Untuk Melakukan Validasi Karya Ilmiah Mahasiswa Berikut:

Nama	: Nurfajar Wahyuliana
NPM	: 186410252
Lembaga Pendidikan	: FKIP Universitas Islam Riau
Program Pendidikan	: Pendidikan Matematika
Program Studi	: Strata Satu
Dosen Pembimbing	: Dr. Dedek Andrian, S.Pd., M.Pd
Judul Karya Ilmiah	: Pengembangan Media Pembelajaran Segitiga Berbasis Adobe Animate CC dengan Desain Pembelajaran ADDIE

Berkaitan dengan Hal tersebut, dimohon kepada Bapak/Ibu dapat memperhatikan hal-hal berikut:

1. Validasi dilakukan paling lama satu bulan setelah surat tugas dan perangkat yang akan divalidasi diserahkan kepada Bapak/Ibu.
2. Validasi dapat dilakukan melalui Daring atau Luring

Demikianlah Surat Tugas Ini dikeluarkan Untuk Dapat Digunakan Sebagaimana Mestinya.

Pekanbaru, 17 September 2022

Mengetahui
Dekan FKIP UIR

Dr. Miranti Eka Putri, S.Pd., M. Ed.
NIDN. 1005068201

Ketua Program Studi

Rezi Ariawan, S. Pd., M. Pd.
NIDN. 1014058701