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Development of Geogebra Assisted Problem-Based Learning Tools to Improve Mathematical Critical Thinking Ability and Self-Efficacy of Students at SMP Negeri 1 Stabat

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Abstract
This study aims to: 1) produce quality problem-based learning tools (valid, practical and effective) for grade VII students of SMP Negeri 1 Stabat; 2) Analyzing the improvement of mathematical critical thinking skills of SMP Negeri 1 Stabat students after being taught using Geogebra-assisted Problem-Based Learning tools; 3) Analyzing the increase in self-efficacy of SMP Negeri 1 Stabat students after using the Geogebra-assisted Problem-Based Learning tool. This research is categorized into development research using the Thiagarajan 4D learning device development model (four-D models). This research was conducted at SMP Negeri 1 Stabat in the even semester of the 2021/2022 academic year. The results showed that: 1) Geogebra-assisted problem-based learning tools in improving students' mathematical critical thinking skills and self-efficacy developed had met the valid criteria with a total average of 4.6, met the practical criteria with the implementation of the problem-based teaching materials used. has an average implementation of 81% in the good category, and meets the effective criteria, one of which is classical completeness reaching 85%, which has met the completeness criteria, namely 85% of students reach the KKM; 2) The improvement of students' critical thinking skills in the first and second trials can be seen in the average critical thinking ability in the posttest results of the first trial, which is 79.3 increasing to 84.7 in the second trial; 3) There was an increase in students' mathematical self-efficacy based on the average score of students' mathematical self-efficacy in the first trial of 3.21 while the average score of students' mathematical self-efficacy in the second trial was 3.45.
Keywords: development of problem-based learning tools, geogebra, critical thinking skills, self-efficacy.
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1. Introduction

Mathematics is a subject that has an important role in human life and the development of science and technology (IPTEK). Progress and development is related to the way and ability to think. In this case, it is necessary to have the ability to think systematically, critically, logically, creatively and innovatively. Learning mathematics is one of the lessons that can train and develop thinking skills.

Seeing the importance of mathematics and its role in facing science and technology and global competition, therefore improving the quality of mathematics education in all types and levels of education must always be pursued. Many efforts have been made to improve the quality of mathematics education by the government. One of them is by improving the Education Unit Level Curriculum by developing the 2013 Curriculum. This can be seen from the current results of students' mathematics learning that has not shown encouraging results. There are many efforts that have been made by the government, especially the ministry of national education and teachers to make improvements to the mathematics learning process itself, either through curriculum revisions and trainings to improve the quality of mathematics teachers. However, the reality is that currently, students' mathematics learning outcomes are still in the low category.

From the results of the PISA survey of junior high school students in 2018, Indonesian students were ranked 75th out of 80 participating countries. The aspects tested in PISA are mathematics, reading and science. For the field of mathematics, the aspects measured are identifying and understanding and using the basics of mathematics that a person needs in dealing with everyday life. Indonesia's position in the field of mathematics is with an average score of 379. This is far below the PISA average score of 489, as well as neighboring Malaysia which ranks 59 with an average score of 440, especially Singapore which is in second place with the average score is 569. Based on the results obtained, it shows the low mathematics learning outcomes of junior high school students in Indonesia.

The learning activities of each student in learning mathematics cannot always take place as expected. Learning difficulties are not always caused by low intelligence factors, but can also be caused by non-intelligent factors. According to Aunurrahman (2011) student learning activities are influenced by internal factors, namely student attitudes, motivation, concentration, study habits and external factors including teacher factors, school curriculum, facilities and infrastructure, students' social environment.

One of the determining factors for a good learning system in schools is the teacher. Therefore, it is necessary to have teachers who are able to carry out the learning process well, who have the main task of educating, teaching, guiding, directing, training, assessing, and evaluating. To carry out their duties properly, a teacher should have professional abilities that support the performance of a teacher. According to Aripin (2017), that professional teachers in the 21st Century must have the ability to facilitate students to have competencies in accordance with what was conveyed by the 21st Century Partnership Learning Framework. The teacher's ability is related to the teacher's ability to prepare methods, strategies, and learning models and to be able to use technology and information media in the learning process.

Before the teacher carries out the learning process in the classroom, there are several things that must be done, namely the first stage of preparation, where a teacher must prepare his learning tools and what materials will be taught in accordance with the applicable curriculum, such as preparing a syllabus, lesson plans. , preparing the application of learning materials such as teaching aids and others, creating a fun learning situation so that students do not feel bored and can play an active role in the learning process, understand the situation of students, understand the initial abilities of students, understand the weaknesses and strengths of students, all of that will be broken down in its implementation in in learning tools.

Devices are a number of materials, tools, media, instructions and guidelines that will be used in the process of achieving the desired activities. And learning is a collaborative process between teachers and students in utilizing all the potential and existing resources, both potential that comes from within the students themselves such as interests, talents and basic abilities, including learning styles and potential that exists outside of students such as the environment, learning facilities and resources as an effort to achieve certain learning objectives.

Quality tools are learning tools that meet the criteria of being valid, practical and effective. According to Nieveen (2007) there are criteria in determining the quality of the results of the development of teaching materials, namely: (1) validity (valid); (2) practically (practical); and (3) effectiveness, so that it can be stated that quality teaching materials are those that fulfill these three aspects. Furthermore, from the statement of Tati, et al (2018: 78) it is concluded that validity is obtained from device validation by experts and colleagues containing content, construct and language validation. Furthermore, practicality means that learning tools can be applied by the teacher as planned and easily understood by students. While the effectiveness is seen from the results of authentic assessments which include an assessment of the learning process and learning outcomes.

According to Tetty and Frida (2018), there are several important points if the teacher prepares learning tools, including: a) Learning tools as a guide, Learning tools are as a guide or giver of direction for a teacher. This is important because the learning process is something systematic and patterned. There are still many teachers who are lost or confused in the middle of the learning process just because they don't have learning tools. Therefore, learning tools provide guidance on what a teacher should do in the classroom. In addition, learning tools provide guidance in developing teaching techniques and provide guidance for designing better tools. b) Learning tools as a benchmark, a professional teacher certainly evaluates each teaching result. Likewise with learning tools. Teachers can evaluate themselves to what extent the learning tools that have been designed are applied in the classroom. This evaluation is important to continuously improve the professionalism of a teacher. Evaluation activities can be started by comparing various activities in class, strategies, methods or even learning steps with the data in the learning device. c) Learning tools as an increase in professionalism, the professionalism of a teacher can be improved with learning tools. In other words, that the learning tools are not only administrative completeness. but also as a medium for increasing professionalism. A teacher must use and develop learning tools as much as possible. Improving everything related to the learning process through the device. If not, then the ability of the teacher will not develop and maybe even decline. d) Simplify, learning tools make it easier for a teacher to help the learning facilitation process. With learning tools, it is easy for a teacher to convey material just by looking at the device without having to think and remember a lot.

So that the learning process will run well if the teacher is able to design learning well, starting from planning learning tools, implementing learning in class, to evaluating it. In carrying out this main task alone, teachers still experience obstacles, even obstacles in making learning tools, carrying out classroom learning, and evaluating learning are relatively high. Making lesson plans is a must for a teacher, because the lesson plans contain important aspects of the teaching and learning process. These aspects include competencies to be achieved, learning objectives, learning materials/materials, learning models, learning methods, and so on.

According to Arikunto (2017) that learning tools provide convenience and can assist teachers in preparing and carrying out teaching and learning activities in the classroom. So with the right learning tools can make it easier for students to learn mathematics. The importance of learning mathematics cannot be separated from its role in various lives, for example, a lot of information and ideas are communicated or conveyed in mathematical language and many contextual problems can be presented in mathematical models. In accordance with Nugroho's opinion (2017) that mathematics is closely related to everyday life so that students will soon be able to apply mathematics in contexts that are useful for students, both in the world of life and in the world of work in the future. In addition, studying mathematics can familiarize someone to think critically, logically, and can

increase their creativity. Apart from the importance of learning mathematics, it turns out that a negative response in the form of views on mathematics subjects was also expressed by the students of SMP Negeri 1 Stabat, including those who said mathematics was a difficult subject, counted a lot, was boring, and the mathematics teacher seemed arrogant in teaching. Furthermore, a planned learning process is needed to change a pleasant learning atmosphere so that it causes students to be active in developing their potential. Learning tools are things that must be prepared by the teacher before carrying out learning. Devices are tools or equipment while learning is a process or way of making people learn. Learning tools include: teacher books, student books, lesson plans (learning implementation plans), and LKS (student activity sheets). The problems that occur in the classroom so that it is necessary to develop a tool, namely lesson plans.

Syahputra and Surya (2017) state that textbooks are textbooks that are used as standard references in certain subjects. The characteristics of textbooks are: (1) a source of teaching materials, (2) a standard reference for certain subjects, (3) arranged systematically and simply. (4) accompanied by learning instructions. According to Trianto (2017: 227) the student book is a guide book for students in learning activities that contains subject matter, concept-based inquiry activities, science activities, information and examples of the application of science in everyday life. The development of a good textbook must meet the criteria of being valid and effective. According to Akbar (2013: 34) good textbooks are: (1) accurate (accuracy); (2) appropriate (relevance); (3) communicative; (4) complete and systematic; (5) student-centered orientation; (6) siding with the ideology of the nation and state; (7) correct language rules, textbooks written using correct spelling, terms and sentence structures; (8) legible, high readability textbooks contain sentence length and sentence structure according to the reader's understanding. However, the reality found in the field is that the textbooks used at SMP Negeri 1 Stabat still have several weaknesses. The textbooks used have not directed students to construct their knowledge and in other words, the material is presented directly in the book.

In this case, mathematics learning must emphasize the opportunity for students to actively work on mathematics based on their abilities, the mathematics learning process in schools so far has been too much on the aspect of doing, but lacking on the aspect of thinking. What is taught in schools has a lot to do with how to do something but less to do with how to do something but less to why it is and what its implications are. In other words, the basis of understanding in learning is only in the form of memorization, not reasoning and thinking skills.

Critical thinking skills are very important for students to exist and navigate life in the 21st century. Whether we realize it or not, mathematics plays a very important role in life. Chukwuyenum (2017: 1) suggests that "critical thinking has been one of the tools used in our daily life's to solve some problems because it involves logical reasoning, interpreting, analyzing and evaluating information to enable one take reliable and valid decisions". Critical thinking is one of the tools used in our daily lives to solve some problems because it involves logical reasoning, interpreting, analyzing and evaluating information to enable someone to make reliable and valid decisions.

The importance of critical thinking skills according to Tety (20017: 50) is because critical thinking skills can support students in decision making, assessment and problem solving. With this ability students can study problems systematically, formulate innovative questions and design original solutions. In line with this, according to Sianturi (2019: 185) by thinking critically, students can achieve a deep understanding. This understanding will help students solve problems in everyday life and help students make the right decisions.

However, the reality on the ground is that this critical thinking ability still seems low. The low ability of students' mathematical critical thinking can be seen from the preliminary study that the researcher did by giving questions to 30 grade VII students of SMP Negeri 1 Stabat with the quadrilateral material. However, only 5 students (16.7%) could answer the questions correctly. Meanwhile, 25 students (83.3%) still could not solve the problem correctly.

Another effective learning model that relates mathematical concepts to everyday life so as to enable students to optimize students' critical thinking skills. One learning model that is directly related to the development of critical thinking skills and is characterized by being student-centered is a problem-based learning model. This learning model demands and builds creative thinking and logical mathematical intelligence. According to Ward and Stepien (2019) the use of problem-based learning models will help students develop critical thinking skills, because in this problem-based learning model students are not only asked to understand a problem but also must be able to work together to solve the problem.

Apart from the problems that existed at the time of observation, it is necessary to know that apart from mathematical critical thinking skills, there is one other important thing that affects student learning achievement, namely students' self-efficacy abilities. One of the goals of learning mathematics in schools according to The Royal Society and Joint Mathematical Council (2016: 19) is to create a positive attitude towards mathematics. This shows that learning geometry not only develops cognitive aspects but also develops affective aspects, such as self-efficacy. Bandura (2017: 2) states that self-efficacy is a person's belief in his ability to produce something. This trust is shown by its performance when carrying out a certain task or demand.

Self-efficacy becomes something very important because people who have high self-efficacy will work hard in doing a task or job and build positive motivation related to the task or work being carried out by Istarani, (2019: 137). With regard to learning, of course, it is highly expected that students have high self-efficacy, meaning that students have high confidence that they are able to complete their lesson assignments and overcome various problems related to the lesson.

In line with the development of information and communication technology (ICT). One of the computer programs that can be used as a medium for learning mathematics is geogebra. With a variety of facilities owned by geogera to demonstrate or visualize mathematical concepts. In addition, geogebra can be installed on a personal computer so that it can be used anytime and anywhere by students and teachers. For teachers, geogebra offers an effective opportunity to create interactive learning environments that allow students to explore various mathematical concepts. Geogebra has several benefits in learning mathematics as explained by researcher Nur (2016) "the use of the geogebra program in mathematics education". Stating that the geogebra program is a program that is quite effective and efficient to help visualize mathematical objects, especially in function and graph material. the use of the geogebra program provides several advantages, namely; paintings that are usually produced quickly and accurately, the geogebra program can provide a clearer visual experience for students in understanding mathematical concepts, can be used as feedback/evaluation to ensure that the paintings that have been made are correct, and make it easier for teachers/students to investigate or shows the properties that apply to a mathematical object.

Based on the explanation above, it is expected that students' mathematical critical thinking skills can be improved through a problem-based learning model assisted by Geogebra software for junior high school students. The use of Geogebra software has also been widely used in mathematics learning such as research conducted by Rudhito (2017) reporting that the use of Geogebra software in mathematics learning is effective and can help students understand the derivative function material carried out in high school. In addition, research conducted by Maryam (2016) concluded that the creativity and understanding of mathematics learning concepts for grade VII students of SMPN 22 Purworejo in the 2012/2013 academic year experienced an increase after participating in ICT-based learning assisted by Geogebra software.

Based on the description above, this research focuses on the development of geogebra-assisted problem-based learning tools which are expected to improve students' mathematical critical thinking skills and self-efficacy so that they can show positive attitudes of students who accept learning mathematics that is more meaningful and will eventually get improved grades in mathematics. mathematics learning outcomes, with this being very important for researchers to do. Therefore, this study entitled **"Development of Geogebra Assisted Problem-Based Learning Devices to Improve Mathematical Critical Thinking Ability and Self-Efficacy of Students of SMP NEGERI 1 STABAT".**

2. Research methods

Types of research

This research is a development research that is used to produce certain products and test the effectiveness of these products. To develop and validate the product, it is combined using the Thiagarajan 4D development model, which consists of four stages of development, namely: define, design, develop, and disseminate.

Research Subjects and Objects

The subjects in this study were students of class VIIA and VIIB of SMP Negeri 1 Langkat T.A 2021/2022, while the object in this study was a learning device based on the Problem-Based Learning model on Quadrilateral material, critical thinking ability and self-efficacy. developed in this study were limited to the Learning Implementation Plan (RPP), Student Activity Sheet (LAS), Student Book (BS), Teacher's Handbook (BPG), Mathematical Communication Ability Test, and Self-efficacy questionnaire.

Data analysis

Data Analysis of Learning Device Validity

This validation is based on the opinion of five experts and practitioners in the field of education. Based on the expert opinion, the average value for each aspect will be calculated so that the average value for the total aspect is obtained.

Data Analysis of Practicality of Learning Devices

Practical criteria by looking at opinions or responses from experts who state that learning tools using problem-based learning models can be used with little or no revision. The way to give an opinion about the practicality of this learning device is to provide a learning device assessment scale along with a learning device validation sheet according to the problem-based learning model.

Implementation of learning devices, provided observation sheets (observations) during the learning takes place. The implementation of the learning activity steps is observed by an observer who has been directed

previously so that he can operate the learning implementation observation sheet correctly. The observation sheet on the implementation of learning devices is made in the form of choices with a score of 1 to 5, with the provisions of a score of 5 (very good), a score of 4 (good), a score of 3 (good enough), a score of 2 (not good), and a score of 1 (not good).).

Data Analysis of Learning Device Effectiveness

Data on the effectiveness of the learning tools developed were analyzed from: (1) data on student learning mastery, (2) achievement of learning objectives, and (3) student responses.

For the effectiveness of learning tools related to mathematical critical thinking skills, it is determined based on the achievement of classical student learning mastery. Minimum completeness is analyzed by considering that students can be said to be complete if the individual student scores reach a score of 80. This 80 is the value of Minimum Completeness Criteria (KKM) for class VII SMP Negeri 1 Langkat. Furthermore, a lesson is said to have been completed classically, that is, at least 85% of students who take the test have achieved a score of 80. Percentage of Classical Completeness (PKK) 85%.

Data Collection Instruments and Techniques

Instrumen Validasi Perangkat Pembelajaran

The learning device validation instrument is a learning device validation sheet that is used to obtain data about the quality of learning tools based on the assessment of experts. Validation sheets for lesson plans, teacher books (BG), student books (BS), and student activity sheets (LKPD). This validation sheet contains the components that are assessed including: format, language, illustrations, and content.

Mathematical Critical Thinking Ability Test Instrument

The test instrument for mathematical critical thinking skills is in the form of a structured description test.

Student Response Instrument

The instrument for student responses is a student response questionnaire which is an opinion or student response to the components and learning tools developed. The technique used to obtain student response data is carried out by distributing Self-Efficacy questionnaires to students. Student responses in this study are students' opinions on interest, feelings of pleasure, currentness, interest, and ease of understanding learning materials through learning tools developed through problem-based learning models

Learning Media Development Procedure

Define Stage

The purpose of the definition stage is to determine and define learning needs by analyzing the objectives and limitations of the material. The activities carried out at this stage are early-late analysis, student analysis, concept analysis, task analysis, and specification of learning objectives.

Design Phase

The basis of the preparation of the test is the analysis of the concepts described in the specification of learning objectives. The test in question is a test of students' mathematical critical thinking skills. To design a test of students' mathematical critical thinking skills, a grid of questions is made based on indicators of students' mathematical abilities and their scoring reference.

Media selection activities are carried out to determine the right media for the presentation of the Quadrangle material. The process of selecting media using geogebra is adjusted to the results of concept analysis and task analysis. From the results of the concept analysis, students are expected to be able to understand the quadrilateral. Thus, the suitable media are visual media, namely books and LKPD.

The selection of formats for RPP, Teacher's Book (BG), Student's Book (BS), and LKPD, is adjusted to the principle. Characteristics and learning steps of the CTL model. The choice of learning format is also adjusted to the 2013 Curriculum. The RPP includes KI, KD, learning indicators, learning objectives, learning materials, learning activities, models, learning methods, learning resources, assessments, which consist of on the instrument, answer key, and scoring guidelines. The activities carried out in this step are writing the initial design of learning tools which include Teacher's Books, Student Books, LKPD, and tests of students' mathematical critical thinking skills. This initial draft is referred to as draft 1.

Development Stage

The following details the steps taken at the development stage, namely:

Validation/Expert assessment (Expert Appraisal)

In this activity an evaluation is carried out by experts in their fields. Expert validation is a technique to get suggestions for improvement as well as an assessment of the learning tools that have been produced at the design stage. The learning tools in question are all materials that have been developed at the design stage.

Trial of Research Instruments

The research instrument used in this study was a mathematical critical thinking test and students' self-efficacy.

Before using the research instrument, the research instrument was first tested on a class outside the sample. Furthermore, validity and reliability tests were carried out. The purpose of this stage is to produce good research instruments, in the sense that they are valid and suitable for use during field trials.

Field Trial

Field trials were conducted to obtain direct input on the learning tools that have been developed so as to produce the final tools. The learning tools were tested in schools to see the practicality and effectiveness of the learning tools that have been designed to improve students' mathematical critical thinking skills.

Stage of Dissemination

This activity was carried out in a limited manner in a discussion forum for mathematics teachers at SMP Negeri 1 Langkat. The result of this stage is to recommend to all teachers of mathematics subjects at SMP Negeri 1 Langkat to use this device as an alternative learning on the Quadrangle material.

3. Research result

Validation of Learning Tools by Using Problem-Based Learning Tools by Using Developed

The research instrument used in this study was a mathematical critical thinking ability test. Before using the research instrument, the research instrument was first tested on a class outside the sample, then the validity and reliability were tested. The goal is to produce a good research instrument, in the sense that it is valid and usable. The results of the validity and reliability test of the instrument are described as follows:

The validity of the questions was analyzed using the product moment person correlation formula, namely by correlating the score of the item with the total score. The test results of the students' mathematical critical thinking ability test instruments are presented in Table 1. below.

Table 1. Validity of Mathematical Critical Thinking Ability Question Items

No	r_{xy}	t_{count}	t_{table}	Interpretation
1	0,91	9.79	2.08	Valid
2	0.92	10.58	2.08	Valid
3	0,87	7.67	2.08	Valid

In Table 1. above, is a test of the research instrument for students' mathematical critical thinking tests for four essay questions with a significant level of 5%, dk = 28, obtained ttable = 2.101. If referring to the test criteria is tcount > ttable, then the critical thinking ability test can be used or is valid. Thus, based on calculations performed manually and excel, it is concluded that the critical thinking ability test can be used or is valid. The results of expert and practitioner assessments on the practicality of problem-based learning tools can be seen in Table 2. below: Practicality of Learning Devices by Using Problem-Based Learning Tools by Using Developed.

Table 2. Learning Tool Validation Results

Validator	Learning Media				
	RPP	LKPD	BS	BG	TKBKM
Validator 1	RK	RK	RK	RK	RK
Validator 2	RK	RK	RK	RK	RK
Validator 3	RK	TR	TR	TR	RK
Validator 4	RK	TR	TR	TR	TR
Validator 5	RK	TR	TR	TR	TR

Information:

RK : Learning tools can be used with “minor revisions

TR : Learning tools can be used “without revision

In Table 2., it can be seen that experts and practitioners state that problem-based tools can be used with little revision and no revision. So, according to the practical criteria, the problem-based tools have met the practical criteria according to the expert.

Furthermore, the practicality of the device will be tested in the field. The implementation of learning tools through PBM was measured using the PBM implementation observation sheet. The results of the data analysis on observing the implementation of PBM tools were concluded that the achievement of the level of implementation of learning tools in the first trial was included in the high category, which means that the PBM tools were said to be practical or applicable.

Effectiveness of Learning Tools by Using Problem Based Learning Tools by Using Developed

PBM tools will be appropriate to use if they can have a positive or significant impact on learning. Thus, the PBM tools developed must meet the effectiveness criteria, namely: (1) classical student learning completeness, namely at least 85% of students who take part in learning are able to achieve a score of 80; (2) the achievement of

learning objectives of at least 75%; (3) a minimum of 80% of the subjects studied gave a positive response to the components of the developed PBM equipment; and (4) the learning time is at least the same as ordinary learning. In the first trial, all of these things have not been fulfilled, so the second trial is carried out again with a description of the effectiveness of the learning device.

The results of students' mathematical critical thinking skills in the pretest trial II were 61.9% while the classical mastery of students' mathematical critical thinking abilities in the posttest trial II was 84.8%. taking the mathematical critical thinking ability test was able to achieve a score of 80. Thus, the posttest results of mathematical critical thinking skills meet classical completeness because they get a percentage of completeness of 84.8%. So it can be concluded that in the second trial the application of learning tools through the Geogebra-assisted PBM device has met the criteria for achieving classical completeness.

The results of the mathematical critical thinking ability in the second trial show that the achievement of learning objectives in indicator 1 is obtained by 92.71%, in indicator 2 it is obtained by 82.81%, in the question of indicator 3 obtained by 78.47%, in accordance with the criteria for achieving goals In learning, it is said that the learning objectives are achieved with the criteria of 75% of the maximum score for each item, thus the achievement of learning objectives in the second trial, namely the posttest results of mathematical critical thinking skills have been achieved for all indicators. Thus, the post-test results in the second field trial have met the criteria for achieving learning objectives. The results of Self efficacy can be seen that the average value on the task difficulty level indicator (Level) is 3.5, the average value on the indicator of the degree of stability, confidence or hope (strength) is 3.4 and the average value on the Area indicator field of behavior (generality) that is equal to 3.4.

The results of the achievement of learning time in the second trial were six meetings. When compared with ordinary learning that has been carried out so far, there is no difference between the achievement of learning time using PBM learning tools in the first trial and the achievement of ordinary learning time.

Thus, it is known that the achievement of learning time using PBM learning tools in trial II is the same as the usual learning time that has been carried out so far, namely six meetings with basic competencies: (1) explaining the properties of rectangles; (2) Solve quadrilateral problems related to flat shapes. This is in accordance with the learning time criteria, namely the achievement of the minimum learning time is the same as ordinary learning, thus the achievement of the second trial learning time has been achieved. Based on the results of the second trial data analysis, it is known that the learning tools developed have been effective.

Improving Students' Critical Thinking Ability

The analysis of increasing students' mathematical critical thinking skills in the first trial will be seen through the N-Gain from the results of the pretest and posttest of students' mathematical critical thinking skills in the first trial. The results of the N-Gain calculation on mathematical critical thinking skills can be seen in the following table:

Table 3. Summary of N-Gain Results of Mathematical Critical Thinking Ability

Trial I

Range	Upgrade Category	Total students	Percentage
N ≥ 0,7	High	2	10%
0,3 ≤ N < 0,7	Medium	16	80%
N < 0,3	Low	2	10%

Based on Table 3 above, it can be seen that 2 students got N-Gain scores in the range > 0.7. For students who experienced an increase in students' mathematical critical thinking skills in the "Medium" category or got an N-Gain score of 0.3 < g 0.7, there were 16 students and 2 people who scored N-Gain g 0.3 with the category " Low". The average gain in the first trial was 0.51 in the medium category. So, it can be concluded that there is an increase in students' mathematical critical thinking skills after applying problem-based learning in the first trial.

The analysis of increasing students' mathematical critical thinking skills in the second trial will be seen through the N-Gain from the results of the pretest and posttest of students' mathematical critical thinking skills in the second trial. The results of the N-Gain summary of mathematical critical thinking skills can be seen in Table 4. below:

Table 4. Summary of N-Gain Results of Mathematical Critical Thinking Ability Test II

Range	Upgrade Category	Total students	Percentage
N ≥ 0,7	High	8	40%
0,3 ≤ N < 0,7	Medium	11	55%
N < 0,3	Low	1	5%

Based on Table 4 above, it can be seen that 8 students got N-Gain scores in the range > 0.7. For students who experienced an increase in students' mathematical critical thinking skills in the "Medium" category or got an N-Gain score of 0.3 < g 0.7 totaled 11 people and 1 person who got an N-Gain score g 0.3 with the category "

Low". The average gain in the second trial was 0.62, namely in the medium category. So, it can be concluded that there is an increase in students' mathematical critical thinking skills after applying learning using problem-based learning tools in the second trial.

4. Discussion

Development of Valid, Practical, and Effective Problem-Based Learning Tools

Learning requires supporting learning tools to simplify the process. Learning in SMP Negeri 1 Stabat students with an age range of 12-14 years which, if referred to Piaget's opinion, then the cognitive development of students at that age is the formal operational stage. During development, there is a process of assimilation and accommodation. Assimilation is a cognitive process by which a person integrates a stimulus that can change new perceptions, concepts, principles or experiences into a schema that already exists in his mind, while accommodation can take the form of forming a new schema that can match the characteristics of the existing stimulus or modifying a suitable schema. with the characteristics of the existing stimulus. In learning, there is a need for a balance between assimilation and accommodation.

Furthermore, Vygotsky states that learning occurs when students work on tasks that have not been studied but those tasks are still in the Zone of proximal development area which lies in problem-solving abilities under the guidance of adults or peers who are more capable. The learning process experienced by students in this study has gone through a process of assimilation and accommodation which is also in the Zone of proximal development. This can be seen from the successful development of a mathematics learning device on quadrilateral material using the development model of Thiagarajan, et al, which is better known as the 4-D model.

The learning tools developed in this study include the Learning Implementation Plan (RPP), Student Worksheets (LKPD), Teacher Books (BG), Student Books (BS) and research instruments.

Based on the results of expert validation for each component of the learning device developed "valid". However, although the components of the learning tools developed have met the criteria for validity, there are several things that must be corrected according to the notes provided by the expert team, including the use of language, writing or typing and displaying images that must be in accordance with clarified conditions. So based on the results of the notes from the expert team that this learning device has met the criteria for validity in the "valid" category with a slight revision note.

The fulfillment of the validity aspect is in line with the opinion of Akker (1999) which states that validity refers to the extent to which the design of the device is based on the latest state of technology, art or science ('content validity') and the various components of the device are consistently related to each other ('content validity'). construct validity').

In addition to validity, practicality is also needed as a condition for good learning tools. In this study, 2 practical indicators were determined, namely the response of the expert team or validator which stated that the learning tools could be used with minor revisions and the implementation of the learning tools was in good criteria.

In addition to practicality, effectiveness is also needed as a condition for good learning tools. In this study, 3 indicators of effectiveness were determined, namely the achievement of student learning mastery, improvement of critical thinking skills and achievement of learning objectives that have reached the specified criteria. The achievement of student learning mastery in the first trial of the two indicators did not meet the specified requirements, while in the trial II has fulfilled classical completeness because it obtained a completeness percentage of 85%. The improvement in critical thinking skills can be seen in the N-Gain scores in the first trial and second trial, each 0.51 and 0.62 which are in the "medium" category. Furthermore, the achievement of learning objectives has been achieved in trial I and trial II because the learning objectives have met the criteria of 75% for all items. This is in line with the opinion of Nieeven (2007) which states that effectiveness refers to the way students carry out curriculum experiences and student achievement outcomes in accordance with the goals set by the developer.

Improving Mathematical Critical Thinking Skills by Using Problem-Based Learning Tools by Using Developed

Based on the results of the analysis of increasing students' critical thinking skills in trials I and II, it shows that the average critical thinking ability in the posttest results of trial I was 79.3 and increased to 84.7 in trial II. Thus, there was an increase in the average value of students' critical thinking skills of 5.4.

It is natural that there is an increase in critical thinking skills by using problem-based learning tools. This is because problem-based learning will improve students' mathematical critical thinking skills because students themselves find problems and concepts, while the teacher's role is to guide students by giving directions (guided) and students are encouraged to think for themselves so they can find general principles based on directions/questions. The questions given by the teacher and to what extent students are guided depends on their

abilities and the material being studied.

This is in line with the research results of Ismail Hanif Batubara (2019) which states that the increase in students' mathematical critical thinking skills taught through problem-based learning assisted by autographs is higher than that taught through problem-based learning assisted by geogebra. Furthermore, Supriadi (2014) from the results of his research reports that aspects of higher-order mathematical thinking skills of students who receive Geogebra-Assisted Blanded Learning are mathematical connection skills, followed by mathematical communication skills, mathematical reasoning and problem solving.

Therefore, in this study it can be concluded that the problem-based teaching materials developed can improve students' mathematical critical thinking skills.

Increasing Mathematical Self Efficacy by Using Problem-Based Learning Tools by Using Developed

The average score of students' mathematical self-efficacy in the first trial was 3.21 while the average score of the students' mathematical self-efficacy in the second trial was 3.45. Based on these data, the overall self-efficacy of students in the second trial was better than the first trial.

This is in line with Riezkia Sholehawati's research (2019) which states that there are differences in the achievement of self-efficacy between students with high, medium, and low initial mathematical abilities. The achievement of self-efficacy of students with high initial mathematical abilities is higher than students with moderate initial mathematical abilities. This is also in line with research conducted by Rahmi (2018) where students' self-efficacy increased between trial 1 and trial 2.

If these results are related to the conclusions of Bandura's (1992) opinion which states that students' mathematical self-efficacy refers to beliefs in one's ability to organize and carry out a series of actions needed to manage prospective situations, then in general students in the second trial are more confident. and diligent in doing math tasks than the students in the first trial.

5. Conclusion

Geogebra-assisted problem-based learning tools in improving students' mathematical critical thinking skills and self-efficacy that have been developed have met valid criteria, namely 1) RPP validation results validated by a team of experts with a total average of 4.64 with valid categories, 2) validation results problem-based student worksheets with a total average of 4.64 with valid categories, 3) student book validation with a total average of 4.63 with valid categories, 4) student book validation with a total average of 4.64 with categories valid, and 5) validation of students' mathematical critical thinking tests, where the expert team stated it was valid and 6) validation of students' mathematical self-efficacy questionnaires, where the expert team also stated that it was valid. 2) Geogebra-assisted problem-based learning tools in improving students' mathematical critical thinking skills and self-efficacy meet the practical criteria, namely 1) The response of the expert team or validator stating that the learning device can be used with minor revisions (2) the implementation of the problem-based teaching materials used has an average implementation of 81% with a good category in trial I and has an average implementation of 85% with a good category in trial II. 3) Learning tools based on problem-based learning in improving students' mathematical critical thinking skills and self-efficacy meet the effective criteria, namely 1) classical completeness reaches 85%, which has met the criteria for completeness, namely 85% of students achieve KKM; 2) an increase in students' critical thinking skills, namely the N-gain in trials I and II of 0.51 and 0.62, respectively; 3) the achievement of learning time which is at least the same as ordinary learning has been achieved; 4) student responses to all aspects, especially to learning tools in the second trial, were above 80%; and 5) an increase in student self-efficacy. 4) An increase in students' critical thinking skills in trials I and II can be seen in the average critical thinking ability in the posttest results of the first trial, which is 79.3 increasing to 84.7 in the first test. try II. Thus, there was an increase in the average value of students' critical thinking skills of 5.4. 5) There was an increase in students' mathematical self-efficacy after using learning tools based on geogebra-assisted problem-based learning that had been developed based on the average student's mathematical self-efficacy score in the first trial of 3.21 while the average student's mathematical self-efficacy score in the second trial of 3.45. Based on these data, the overall self-efficacy of students in the second trial was better than the first trial.

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