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Development of Lkpd Using a Creative Problem Solving Learning Model Assisted with Geogebra to Improve Mathematical Problem Solving Capability and Competition Strength

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ABSTRACT

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This study has two objectives. The Creative Problem Solving and GeoGebra learning approaches will be used to create Learning Tools and Problem Documents (LKPD). Based on the validity, practicality and efficacy in improving students' problem-solving abilities and mathematical resilience, LKPD will be created. Second, this study will explain how LKPD and the Creative Problem Solving learning paradigm using GeoGebra can improve students' problem-solving abilities and mathematical resilience. This research method is a type of ADDIE development research. This study follows the ADDIE model—Analysis, Design, Development, Implementation, and Evaluation. Based on this study, the Creative Problem Solving learning paradigm using GeoGebra helps create valid, practical and successful LKPD. In addition, students' mathematical problem-solving abilities have increased. LKPD that applies the Creative Problem Solving paradigm with GeoGebra has been proven to improve students' problem-solving abilities. Students' fighting spirit is included as an indication of Quitters in this study. Trial II showed that students' fighting spirit had reached the Climbers indication stage.

A. INTRODUCTION

Science and technology grow from mathematics, a universal topic. Mathematics is abstract, based on axiomatic logical thinking, consistent, and based on agreement, according to (Suharto., 2017). Mathematics helps build Science and Technology because of its uniqueness. Mathematics must be mastered from an early age to be successful in science and technology. Elementary to college level mathematics is required. Thus, understanding mathematics helps humans think critically, systematically, rationally, creatively, and together to achieve tasks. Problem solving, reasoning and proof, communication, connection, and representation are mathematics learning skills. (Widyasari, N., Dahlan, JA, Dewanto, 2016).

This means that mathematics education aims to teach problem solving to students. Problem solving is the heart of mathematics, said (Bhat, 2018). According to (Rahayu, 2019), school mathematics emphasizes problem solving. Problem solving skills are essential to mastering mathematics in school. It is very important to teach problem solving skills to students from an early age (Arslan, 2019). This means that students must have problem-solving skills to be ready to face the difficulties of mathematics and life. At the 2018 PISA level, Indonesian students scored 379, below average (Schleicher, 2019). Indonesian students' arithmetic scores have declined since then (OECD., 2018). The average PISA score in 2015 was 386 and dropped 7 points in 2018. This brought Indonesia down to 72nd position from 78th position. Based on the PISA results, students only work on simple tasks. PISA math problems assess reasoning, argumentation, and problem solving above computation and memory (Aini, R. M., & Siswono, 2014). Looking at the PISA findings, it can

be seen that students' math problem-solving abilities are still developing and require strong thinking. Students' quantitative problem-solving abilities are competent but need to be improved, especially in vocational schools, according to (Kushendri and Zanthy Luvy Sylvianna, 2019).

This study examines the problem-solving abilities of vocational high school students. Government-owned vocational high schools (SMK) equip middle-class graduates to work. This study uses SMK as a benchmark because this school fulfills its specific objectives, namely (1) preparing its students to become productive and independent workers who can fill middle-level job vacancies in the education sector. competency of the selected program expertise, (2) helping students choose jobs and work together persistently. Fighting spirit is very important to achieve the four goals of vocational high schools and develop leaders. (Fardani, Z., Surya, 2021) observed students' answers showed that they could not write what they knew or needed based on the facts they had..

Understanding problems, planning, working and checking are mathematical problems (Polya, 1973) Steps to Completing SMK Negeri 1 Tebing Tinggi Serdang, Bedagai Regency also needs to strengthen mathematical problem solving abilities

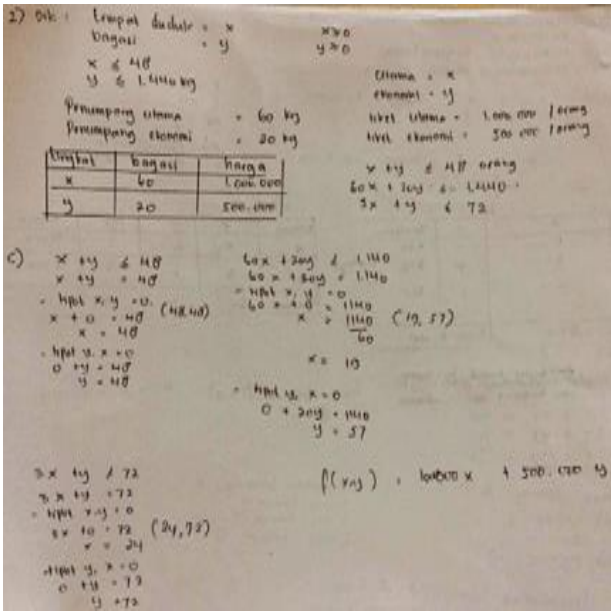

Figure 1. Examples of student errors on observation questions

Of the 28 students who took the problem-solving ability observation test, only 2 achieved learning completion (7.14%), while 26 students did not achieve learning completion (92.86%). The class has not met the classical objectives of student completion, even though current mathematics learning aims to develop problem-solving skills.

Based on the observation results, students' ability to understand problems is classified as moderate (71.43%), while the ability to plan and implement problem solving is classified as very low (32.14% and 32.14%). Assessment of students' ability to understand problems is 44.05% and rechecking 25%. However, many students made mistakes on the problem-solving ability test, based on observation assessments.

Students' problem-solving skills must be developed to solve complex mathematical and life challenges (Ulya, 2015). (Nurrahman, 2017) found that mathematics LKPD in schools has not maximized children's capacity and creativity in mathematics. In addition, LKPD learning activities focus more on problem solving and mathematical logic intelligence.

Based on the results of observations, there are several phenomena that occur in some students in the class, including some who do not pay attention to the teacher, many are late in submitting assignments, and some do not complete them. When practicing at home, many students ask about toilet breaks and excessive use of cellphones in class.

The results of initial observations and unstructured interviews with grade XI mathematics teachers at SMK Negeri 1 Tebing Tinggi, Serdang Bedagai Regency in the learning process show that students' mathematical problem-solving abilities need to be improved. This is because students are still passive and have not been able to express ideas creatively when solving problems, and conventional learning methods, models, and materials from teachers do not help students solve problems. students' arithmetic problems, teachers are less innovative in designing student worksheets to support effective learning outcomes, and do not utilize computer technology-based learning resources to help students understand mathematics.

Teacher innovation is very much needed to improve education, especially in vocational schools due to limited media and teaching materials. Media or student learning resources are needed. Teachers can innovate by creating Student Worksheets. LKPD is an integral aspect in the learning process and functions as a guide for teachers in achieving curriculum goals. This assesses how well the learning material is delivered, what indicators are to be achieved, and what the teacher will do next. LKPD also wants to help students in learning mathematics. Based on an unstructured interview with Mrs. Ramadayanti, S.Pd, a mathematics teacher at SMK Negeri 1 Tebing Tinggi, Serdang Bedagai Regency, the Learning Implementation Plan (RPP) has been submitted to the principal and supervisor since the current semester. She has the Learning Devices (RPP) because she downloaded it from the internet and edited the name of the school and the cover without reading it. Based on the results of observations at SMK Negeri 1 Tebing Tinggi, Serdang Bedagai Regency, the Student Worksheets (LKPD) used in schools were not developed by subject teachers but instead made students bored in learning.

Figure 2. Cover of front and back views of Class XI TKJ-1

Figure 2 shows that the LKPD used at SMKN 1 Tebing Tinggi, Serdang Bedagai Regency was not made by teachers to meet student needs, but was printed directly without being modified so that it seemed monotonous.

The level of student intelligence needs to be considered when assessing mathematical problem-solving abilities because the level of intelligence affects student learning outcomes and learning achievements. Nurfatanah, Rusmono, 2018 said that students' internal characteristics can affect their ability to acquire a talent, especially problem solving. The Fighting Power Instrument assesses resilience and success. Thus, fighting power is very important for student learning outcomes and learning achievements, especially problem solving.

Research on fighting power has produced good results in learning activities, such as the correlation between mathematical critical thinking skills and types of fighting power (Rahayu, Diar Veni, Afriansyah, 2015). Therefore, mathematical fighting power affects success. According to (Ahmad, 2015), Fighting Power affects Problem Solving Ability. Thus, students' fighting power increases problem-solving abilities. The more human resources stop and consider this difficult, the busier they will be. Researchers will help students build their skills by using learning media to encourage the development of science and technology and learning

objectives, such as problem solving. (Arsyad, 2015) stated that learning media is one component of the learning system, therefore the selection criteria are based on this.

GeoGebra software is a manipulative learning tool. GeoGebra is a mathematics learning software that encourages creativity and active participation, which aims to improve student skills. The GeoGebra computer program teaches geometry and algebra, according to (Lestari, 2018). GeoGebra software was developed for teaching and learning mathematics in schools. For the purpose of solving mathematical problems, producing mathematical teaching materials, and learning arithmetic. GeoGebra applies LKPD-based learning in this study. Based on the description above, the researcher is interested in conducting research with the title, "Development of LKPD with the Creative Problem Solving Learning Model Assisted by GeoGebra to Improve the Problem Solving Ability and Fighting Power of Vocational School Students

B. RESEARCH METHODS

This research includes development research that creates the product but also evaluates how well the product works. This project will develop Student Worksheets (LKPD) with the Creative Problem Solving (CPS) learning paradigm, with the help of GeoGebra, using circular material. Through participation in this initiative, children will be able to increase their capacity to answer mathematical problems and their fighting power. Hamlet IX, Paya Bagas Village, Tebing Tinggi District, Serdang Bedagai Regency, North Sumatra is the research location. SMKN 1 Tebing Tinggi is the research location. In the even semester 2022/2023 research will be carried out. The subject of the investigation is the class.

For the purposes of this investigation, the stages of the ADDIE development model were used. The ADDIE paradigm steps (Branch, 2009) can be used to create and build LKPD. Analysis, design, development, implementation and assessment are things that effectively and efficiently achieve their goals. Apart from that, there is an evaluation stage. An illustration that provides a visual representation of the evolution of the ADDIE LKPD model can be seen in the following image

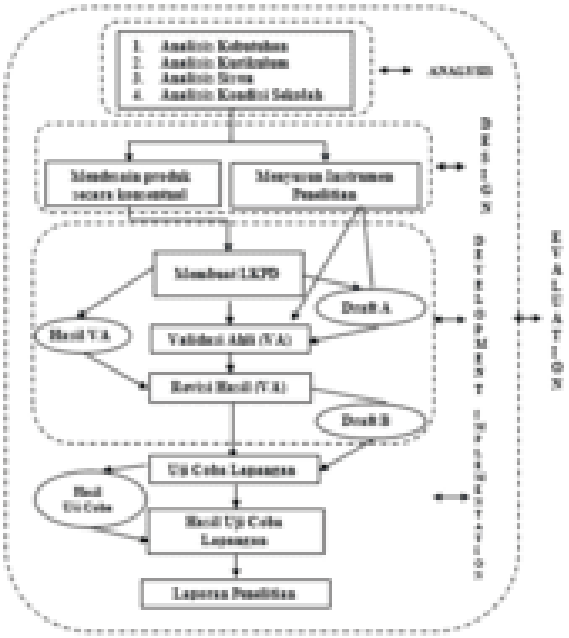

Figure 3. ADDIE Development Scheme

C. RESULT AND DISCUSSION

Desain

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Table 1. Device Validation Results

No	Aspect	Average	Category
1	Lesson plan	4,5	Very Valid
2	Student Worksheets	4,4	Very Valid
3	Problem solving Ability Test	4,3	Very Valid

Table 1 shows that the average validation of the RPP, LKPD, and Problem Solving Ability Test is 4.4. The results of expert validation are what are called validity criteria. Based on these criteria, the RPP, LKPD, and problem solving ability tests are "very valid".

Implementation

Presentations were given by researchers during this trial. Form a study group with five other students of the same age. To provide students with a variety of educational opportunities, group members have varying levels of academic ability. The characteristics and abilities of heterogeneous groups are on average comparable.

Trial I: Creative Problem Solving Learning Model Assisted by GeoGebra

This research will use a student response questionnaire to the LKPD and the Fighting Power questionnaire to assess their usefulness. The resulting LKPD is tested for student reactions and learning success. Table 2 shows the answers to the student LKPD questionnaire

Table 2. Student Response Questionnaire on LKPD

No	Aspect	Valuation Percentage	Criteria
1	Clarity	73,3%	Practical
2	Ability to Give References	80%	Practical
3	Convenience	86,7%	Quite Practical
4	Curiosity/Interest	90%	Quite Practical
Average Valuation Percentage		82,5%	Practical

Analysis of Student Mathematical Problem Solving Ability Test Results in Trial I

In this research, the level of student capacity in solving problems is used to evaluate student mastery. This evaluation is carried out with the help of a test of students' problem solving abilities which has been formulated by experts or validators and validated by them. Table 3 contains a description of experimental findings on students' mathematical problem solving abilities. Information can be seen in the following table:

Table 3. Results of Mathematical Problem Solving Ability in Trial I

Information	*Pre-Test*	*Post-Test*
The highest score	62.5	67
Lowest Value	21	42
Average	46	58

Table 3 shows that initially the students' average mathematical problem solving ability was 46, but at the end of the test it increased to 58. Students did not receive LKPD which was built using the Creative Problem Solving learning model assisted by GeoGebra, to study information related to the questions presented. As a result, student learning achievement in the pretest and posttest increased. Students will learn information

related to the questions given through the LKPD during the posttest. Based on the results of the student's classical achievement trials, it is shown in Table 4:

Table 4. Classical Success Level of Students' Mathematical Problem Solving Ability in Trial I

Category	*Pre-Test*		*Post-Test*	
	Student	Percentage	Student	Percentage
Succeed	3	12%	5	20%
Not successful	22	88%	20	80%
Amount	25	100%	25	100%

Table 4 shows that 5 out of 25 students passed the final test of mathematical problem solving abilities, or 20% of students obtained traditional scores.

Description of the Results of the Student Fighting Strength Questionnaire in Trial I

Data from pre-test and post-test results are used to assess the distribution of students' fighting abilities through surveys. The fighting spirit questionnaire was given to students on two different occasions, namely: first, before the learning activities began using the LKPD that had been prepared (pre-test), and then after the activities began. To find out whether the LKPD built using the Creative Problem Solving and GeoGebra learning models on circular material provides an increase in students' fighting abilities, a before and after test was developed. A summary of the findings of the student fighting ability test is presented in Table 5.

Table 5. Description of the Results of Student Fighting Power in Trial I

Information	Results of Fighting Power	
	Pre-Test	*Post-Test*
The highest score	38	54
Lowest Value	5	22

Based on the results of the pre-test and post-test, students generally got a score of 5 on the first exam and 38 on the second exam, and 22 and 54 on both exams. Experiment aimed at improving students' problem solving abilities. The first trial will show that students' mathematical problem solving abilities have increased, as evidenced by the N-Gain of pre-test and post-test problem solving abilities. This will be determined on the first try. Evaluation of students' abilities in solving mathematical problems is presented in Table 6. N-Gain test:

Table 6. Summary of N-Gain Results for Problem Solving Ability Trial I

Skor *N-Gain*	Criteria *N-Gain*	The Number Of Student
$N - Gain > 0{,}70$	Tall	0
$0{,}30 < N - Gain \leq 0{,}70$	Currently	3
$0{,}00 < N - Gain \leq 0{,}30$	Low	22

The N-gain figure obtained shows that the overall increase in students' mathematical problem solving abilities that took place in trial I was in the medium category with an N-gain percentage of 36%.

The results of the mathematical problem solving ability test given to students in trial II were analyzed.

The aim of this research is to find out how much mathematical problem solving knowledge students have by using tests that have been designed and validated by experts and specialists in their fields. In the second experiment, the results of students' efforts in solving mathematical problems are presented in Table 7. Using the Creative Problem Solving and GeoGebra learning models, we will analyze all metrics for the effectiveness of the LKPD. The results of this analysis will be presented in the following table.

Table 7. Description of Problem Solving Ability Results in Trial II

Information	*Pre-Test*	*Post-Test*

The highest score	71	92
Lowest Value	25	67
Average	47	79

Table 7 shows that the students' pretest mathematical problem solving ability was 47 and their posttest was 92. Table 8 shows the traditional success of students in solving mathematical problems in trial II:

Table 8. Classical Success Level of Students' Mathematical Problem Solving Ability in Trial II

Category	*Pre-Test*		*Post-Test*	
	Student	Percentage	Student	Percentage
Succeed	4	16%	20	80%
Not successful	21	84%	5	20%
Amount	25	100%	25	100%

As can be seen in Table 8, twenty of the twenty-five students who took the final test on their mathematical problem solving abilities were successful or obtained a score of eighty percent, with the majority passing the post-test classically. manners.

Results of the Test II Students' Fighting Strength Questionnaire

A fighting ability division test was administered to students, and data was collected before and after the test for the purposes of this study. Before and after completion of the learning process, the developed LKPD is used to provide pre-test and post-test questionnaires to students to evaluate the student's level of determination and determination to succeed. Students were given a pre-test and post-test after receiving learning treatment with LKPD which was built using the Creative Problem Solving and GeoGebra learning models on circle material. The purpose of the test is to determine the student's ability to fight his opponent. The findings of the fighting power test given to students in trial II are presented in Table 9.

Table 9. Description of the Results of Students' Fighting Power in Trial II

Information	Results of Fighting Power	
	Pre-Test	*Post-Test*
The highest score	71	88
Lowest Value	28	45

In the pre-test, the average student's fighting power got the lowest score, namely 28, and the best score was 71. Meanwhile, in the post-test, the student's fighting power got the lowest score. score, namely 45, and the largest score is 88. This information is presented in Table 9.

Improving the Problem Solving Abilities of Trial Students II

When students take the second trial, their ability to solve mathematical problems will increase, this is indicated by the N-Gain determined before and after the initial test. N-Gain of students' skills in solving mathematical problems throughout trial II is summarized in Table 10 which has been provided for convenience.

Table 10. Summary of N-Gain Results for Problem Solving Ability Trial II

Skor *N-Gain*	Criteria *N-Gain*	The number of students
$N - Gain > 0{,}70$	Tall	4
$0{,}30 < N - Gain \leq 0{,}70$	Currently	16
$0{,}00 < N - Gain \leq 0{,}30$	Low	5

Based on the N-gain value obtained, the overall increase in students' mathematical problem solving abilities in trial II was classified as being in the medium group with an N-gain percentage of forty percent.

DISCUSSION

According to the research results, students at SMK Negeri 1 Tebing Tinggi, Serdang Bedagai Regency, improved their mathematical problem-solving skills and fighting power by solving the Student Worksheets (LKPD) accurately. Fighting power affects pupils' arithmetic problem-solving (Hakim, 2020). According to mathematical goals, students must be persistent (Kemendikbud. 2016, n.d.). This is crucial since students may encounter several challenges during problem solving. Teachers should investigate student problem-solving behaviour to increase student performance (Haleva, L., Hershkovitz, A., & Tabach, 2021). Accordingly, kids' fighting capacity shows their problem-solving ability. Students' diverse answers to situations might be seen as Fighting Strength (Saniyyah, F., & Triyana, 2021). Strength, struggle, desire, and a never-give-up mentality are essential to succeed (Apertha, F. K. P., Zulkardi, 2018). The LKPD created in further study helps pupils solve challenges. LKPD was created to scaffold students' problem-solving skills. According to prior research, Fighting Power promotes accomplishment, independence, and learning achievement motivation, which affects kids' arithmetic performance. This matches study at SMK Negeri 1 Tebing Tinggi, Serdang Bedagai Regency.

LKPD and the Creative Problem Solving (CPS) learning paradigm improved students' problem-solving and fighting ability in this study. The LKPD includes practice questions and contextual problems taught systematically and explicitly at each step using the CPS learning model and Problem Solving Ability (Polya) indicator. The LKPD also includes encouraging lines and slogans to help pupils at SMK Negeri 1 Tebing Tinggi, Serdang Bedagai Regency handle arithmetic issues.

The Creative Problem Solving (CPS) learning model and GeoGebra, starting with CPS problems, are linked to students' increasing problem-solving and fighting power in this research. Effective problem-solving behaviours and dispositions are needed for CPS learning to be successful. Giangreco (1994) lists six characteristics of CPS learners: (1) Problem solvers believe that everyone is creative and can solve problems, so they are given the chance to find solutions; (2) Optimistic about problem solving, which shows that every problem can be overcome and has a solution; and (3) Alternative problem solving using divergent and convergent thinking. CPS learning supports Polya's issue solving stage indicators—understanding the problem, planning, doing, and checking—so problem solving may run effectively. In addition, instructors may motivate and excite children to boost their fighting capacity. Student-centered learning allows instructors to spend more time with pupils, getting to know their personalities and character, so they may be taught better. Presenting the notion of the Creative Problem Solving learning model, Problem Solving Ability, and Fighting Power shows how this study succeeded. The Creative Problem Solving learning syntax improves students' mathematics problem-solving. This research needs teacher motivation and support, especially since the students being taught are Vocational High School (SMK) students who are determined to work right away rather than continue their education.

D. CONCLUSION AND SUGGESTIONS

This study's discussion and analysis yields these conclusions: LKPD using the Creative Problem Solving approach and GeoGebra learning paradigm are effective in SMK Negeri 1 Tebing Tinggi in Serdang Regency. tools that may help pupils solve problems and have additional options. Not identical. SMK Negeri 1 Tebing Tinggi students in Serdang Bedagai Regency may develop their problem-solving and critical thinking abilities using Student Worksheets (LKPD) that integrate Creative Problem Solving and GeoGebra. The Learning program with the Creative Problem Solving Approach and Student Worksheets (LKPD) implemented using GeoGebra at SMK Negeri 1 Tebing Tinggi in Serdang Bedagai Regency has improved students' problem-solving and critical thinking abilities. Creative Problem Solving and GeoGebra Student Worksheets (LKPD) at SMK Negeri 1 Tebing Tinggi in Serdang Bedagai Regency clearly increase students' mathematical problem-solving skills. This is seen by the high n-gain increase from experiment I to experiment II.

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