

# Development of Learning Device with a Creative Problem Solving Model Helped Use GeoGebra Software to Enhance Students Ability to Solve Mathematical Problems

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**Abstract.** The general purpose of this research is to develop and produce a learning device with a creative problem-solving model helped use GeoGebra Software to enhance students ability to solve mathematical problems, while the specific purpose of this research is to know the validity, Practicality, and effectiveness of learning device and to analyze the increasing of students mathematical problem-solving capabilities. This research using a 4-D Models stage of define, design, develop and disseminate but limited only to the develop stage then implement the learning device. The subject of this research is students grade XI MIPA SMA Negeri 18 Medan for the limited and first trial. The object of this research is a learning device developed with a Creative Problem-Solving model helped use GeoGebra Software that consists of Study Plan, Students Book, and Students Activity Sheet. The results show that learning device developed had been categorized with valid, practical and effective.

**Keywords:** Learning Device, Creative Problem Solving Models, Software GeoGebra, Problem Solving Ability

## 1. Introduction

Learning mathematics is an essential thing so that students can improve their logical thinking ability and develop many challenging problem solving abilities. But it is unfortunate that students already thought that math lesson was a difficult one as they got so many formulas to memorize. [1]. Based on the statement before that was found at school, mathematics is the most difficult subject that thought by the students so that it is difficult for students to achieve mathematical problem solving abilities. It can be shown from their Mathematics National Examination that still below standart [2]. Most of students did not graduate due to their marks in Mathematics National Examination. Besides that, it also can be shown from International Test hosted by *Programme for International Student Assesment* (PISA) in 2018 in which Mathematics result was down in that year and it shown that students mathematical thinking abilities still need to increase [3].

In this study, the researcher had observed in SMA Negeri 18 Medan and got that students mathematical problem solving ability still need to increase. The observation result got from 28 students that follow the test, only 2 students that passed or in percentages, it is 7,14%. It shows that the class had not reached the classical target of student completeness, which is 85%, even though one of the goals of learning mathematics is to develop problem solving abilities. The researcher got several problems from the students and also the school, namely;

(a) Students were still passive and cannot creatively express ideas, (b) The learning method used by the teacher was still conventional, (c) The device and learning models used by the teacher had not been supported to improve students mathematical problem solving abilities, (d) Teachers had difficulty using learning media with computer technology that can help students understand mathematical topic.

In an effort to improve students mathematical problem solving abilities in Indonesia, it is the responsibility of teachers to think about, develop and implement learning according to their needs and package learning processes that are more meaningful, interesting, and follow the development of science and technology. The responsibility that can be done by teachers to increase students mathematical problem solving abilities is by developing learning tools and choose the right learning model to be applied in learning mathematics. Learning devices can be packaged together with the right learning model so that they are able to support the measured achievement. One of the learning models that according to researcher can be the answer to improve students mathematical problem solving abilities is the Creative Problem Solving (CPS) learning model. According to [4], Creative Problem Solving (CPS) learning model is one of the learning models that can practice students when they faced with a question, students can do problem solving abilities to choose and develop their responses. And not only by memorizing without thinking, but problem solving abilities also expand students creative thinking processes.

Furthermore, in supporting the development of science and technology and the achievement of learning objectives, namely improving problem solving abilities, researcher also assist students in developing their abilities through the using of learning media. The learning media chosen by the researcher is the GeoGebra software. GeoGebra is one of the learning software that can be used in learning mathematics that gives students a more active role and makes students more creative and it also hoped that students abilities will increase. The GeoGebra software developed for the teaching and learning process of mathematics in school which were observed to have at least three uses, namely as mathematics learning media, tools for making mathematics teaching materials, and solving math problems [5].

Based on the background described, the researcher feels that need to conduct a research entitled the Development of Learning Device with a Creative Problem Solving Model Helped Use GeoGebra Software to Enhance Students Ability to Solve Mathematical Problems.

## **2. Methods**

This research was conducted online (on the network) using the zoom meeting application and google classroom in class XI MIPA SMA Negeri 18 Medan in the odd semester of the 2020/2021 academic year. The subjects of this study were students of SMA Negeri 18 Medan class XI MIPA 4 as many as three students for a limited trial and students of class XI MIPA 3 as many as 10 students for trial I (trial learning devices). The selection of the subjects of this study used a purposive sampling technique based on the results of discussions with teachers at school. The selection is heterogeneously based on students ability. The object of this research is a learning device developed with the Creative Problem Solving model helped by GeoGebra software to improve students mathematical problem solving abilities in the form of Lesson Plan, Students Book and Students Activity Sheets in Circle Topic.

The type of this research is Research and Development (R&D) using the Four-D Models (4-D) developed by Thiagarajan and Semmel which consists of the stages of define, design, develop. and disseminate [6]. However, this Research and Development is limited only to the development stage. The fourth stage, namely dissemination is not carried out due to the pandemic situation and conditions, limited time, funds, and also researchers capability, but

will apply learning tools trial with the aim of improving students mathematical problem solving ability.

The research instruments include (a) Validity, they are: (1) Lesson Plan Validation, (2) Students Book Validation, (3) Student Activity Sheet Validation, (4) Problem Solving Ability Test Validation, (5) Teachers Response, and (6) Students Response. The validity criteria can be shown in this table below [7].

**Table 1. Validity Criteria**

No.	Validity	Criteria
1.	$1 \leq VR < 2$	Not Valid, <i>cannot be used</i>
2.	$2 \leq VR < 3$	Not Valid, <i>cannot be used but still can revise</i>
3.	$3 \leq VR < 4$	Valid, <i>can be used by a bit revise</i>
4.	$4 \leq VR \leq 5$	Very Valid, <i>can be used without revision.</i>

The research instruments include (b) Practicality, they are: (1) Teachers Response, (2) Students Response. The Teachers Response Practicality using this formula [8]:

$$P = \frac{f}{N} \times 100\% \quad (1)$$

Description:

P = Practicality Mark (%)

f = Score

N = Total Score

(2) The Students Response Practicality using this formula [6]:

$$PRS = \frac{\sum A}{\sum B} \times 100\% \quad (2)$$

Descriptions:

PRS = Percentages of total students giving positive response

$\sum A$  = Proportion of students choose

$\sum B$  = Total Students (Respondent)

The research instruments include (c) Effectiveness, they are: (1) Classical Learning Completeness, and (2) Achievement of Learning Indicators.

(1) The criteria of Classical Learning Completeness state that students have been able to solve mathematics problems if there are 85% of students get a minimum score of 70. The percentage can be calculated by the formula [6]:

$$PKK = \frac{X}{N} \times 100\% \quad (3)$$

Descriptions:

PKK = Percentage of Classical Learning Completeness (%)

X = Total students get marks minimal 70

N = Total students

(2) The criteria of Achievement Learning Indicators if at least 75% of the indicators formulated can be achieved by 65% of students [9]. The percentage can be calculated by using this formula [10]:

$$r_i = \frac{\text{the total score of students in indicator-}i}{\text{the maximum score of students in indicator-}i} \times 100\% \quad (4)$$

Descriptions:

$r_i$  = Percentage of Achievement Learning Indicators

$i$  = 1,2,3,...

The Category of Problem Solving Ability Score Test can be seen in this table below [9]:

**Table 2. Category of Problem Solving Ability Score Test**

Achievement	Category
$90\% \leq r_i \leq 100\%$	Very Good (Achieved)
$80\% \leq r_i < 90\%$	Good (Achieved)
$65\% \leq r_i < 79\%$	Enough (Not Achieved)
$55\% \leq r_i < 65\%$	Low (Not Achieved)
$0\% \leq r_i < 55\%$	Very Low (Not Achieved)

To find out the increase in students mathematical problem solving abilities, the n-gain formula is used as below:

$$g = \frac{S_{post\ test} - S_{pre\ test}}{S_{maks} - S_{pre\ test}} \quad (5)$$

Descriptions:

$S_{posttest}$  = the score of *posttest*

$S_{pretest}$  = the score of *pretest*

$S_{maks}$  = the maximum score

The Category N-gain can be seen in this table below [11]:

**Table 3. Category of N-gain**

Interval N-gain	Category
$g \geq 0,70$	High
$0,30 \leq g < 0,70$	Medium
$g < 0,3$	Low

### 3. Results and Discussion

The data obtained in this study is the development of learning device with a Creative Problem Solving Model Helped Use GeoGebra Software to Enhance Students Ability to Solve Mathematical Problems. The final results of this study is told that the device developed can help students to enhance their ability to solve mathematical problems by using Students Book, Students Activity Sheet and also Problem Solving Test. For the result, it will shown below from the table 3 the comparison of validity in limited trial and first trial of the learning device, table 4 the comparison of validity in limited trial and first trial of the learning device and table 5 the comparison of effectivity in limited trial and first trial of Problem Solving Test.

**Table 4. The Comparison of Validity in Limited Trial and First Trial**

Category	Limited Trial	First Trial
Lesson Plan	Valid	Very Valid
Students Book	Valid	Very Valid
Students Activity Sheet	Valid	Very Valid
Problem Solving Test	Valid	Very Valid

In validity, there are some of cases that need to revise even though all of the devices already valid. The validators want all devices to be filled with GeoGebra software so that the application of the material on the developed device is clearly visible in daily life.

**Table 5. The Comparison of Practicality in Limited Trial and First Trial**

Category	Limited Trial	First Trial
Teachers Respond to Lesson Plan	Practical	Practical
Teachers Respond to Students Book	Enough	Practical

Teachers Respond to Students Activity Sheet	Practical	Very Practical
Students Respond to Students Book	Very Practical	Very Practical
Students Respond to Students Activity Sheet	Practical	Very Practical

In Practicality, there are some marks by teacher and students that need to add and subtracted so that in First trial, every students can see and solve every materials in the devices.

**Table 6. The Comparison of Effectiveness in Limited Trial and First Trial**

Category	Limited Trial	First Trial
Average marks of Class	68,1	80,08
Classical Learning Completeness	Not Achieved	Achieved
Achievement Learning Indicators	Not Achieved ( <i>Posttest</i> )	Achieved ( <i>Posttest</i> )

In effectivity, the difference in the rates is very clear, it means students had increased their problem solving ability as they had achieved the Problem Solving Test and the devices are effective.

To know the increase in Students Problem Solving Ability, the researcher use Normalized-Gain (N-gain) by using the formula in Methods. The N-gain gets 0,49 and it is in medium category.

$$g = \frac{S_{posttest} - S_{pretest}}{S_{maks} - S_{pretest}} = \frac{80,08 - 61,32}{100 - 61,32} = \frac{18,76}{38,68} = 0,49$$

This study is supported by the results of research conducted by Treffinger and Isaksnes [12] concluded that learning mathematics using Creative Problem Solving Model is effective to help students solve the problem. Research by Cahyono [13] also states that Creative Problem Solving Model is an effective model to use by developing some devices of Mathematics at school and also to support student learning outcomes.

#### 4. Conclusion

Based on the results above, it can be concluded that Students Problem Solving Ability had increased by Development of Learning Device with a Creative Problem Solving Model Helped Use GeoGebra Software. Devices such as Lesson Plan, Students Book, Students Activity Sheet and also Problem Solving Test are Valid, Practical and also Effective to use by students.

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