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# Development Of Mathematics-Based Learning Media Problem-Based Android-Assisted Learning For Students Grade VIII Junior High School

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**Keywords:** Learning Media; Problem Based Learning Model; Problem Solving Ability; Macromedia Flash

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## Abstract

This study aims to produce teaching materials based on the Adroid-assisted problem based learning model to improve students' mathematical problem solving skills that are valid, practical, and effective. This is motivated by the low ability to solve mathematical problems of students from SMPN 15 and Madrasah students from previous research, as well as the lack of utilization of digital Learning media in the process of learning mathematics. The research procedure is guided by the design of Plomp development. The development Model studied by Plomp is the initial investigation phase, the development or prototyping phase, and the research phase. The population in this study is eighth grade students MTsN 1 Padang. Data collection instruments are in the form of initial investigation phase instruments with interview guidelines, student opinion questionnaires, student test sheets. Instrument for validity test. Instrument for practicality test. Instrument for effectiveness test. The results of this study showed the assessment of the material aspects by mathematics education by 86.67%, for linguists by 93.75%, and for educational technologists by 80%. Thus obtaining an average score of 86.81% with very valid criteria. Based on the results of the practical test of teaching materials by teachers and students get an average score of 86.78% with this score included in the criteria of very practical. The score obtained from the teacher's practicality test was 85% and the student's practicality test was 88.57%.

**How to cite:** Bintang, A., Asmar, A., Arnawa, I., & Musdi, E. (2025). Development Of Mathematics-Based Learning Media Problem-Based Android-Assisted Learning For Students Grade VIII Junior High School. *JETL (Journal of Education, Teaching and Learning)*, 10(1). doi:<http://dx.doi.org/10.26737/jetl.v10i1.7048>

## INTRODUCTION

Based on the results of interviews with teachers in the field of mathematics studies at MTsN 1 Padang, the impact of changes in the learning system that occurred due to the outbreak of the

COVID-19 virus has many students who have difficulties in solving mathematics problems because most students still need direct explanations by teachers in answering questions. Even when carrying out daily tests, many of the students do not do even though the time given is more than doing the daily tests at school. Another factor that causes low mathematical problem-solving skills is conventional forms of learning such as lectures held at school, conventional forms of learning cause low motivation of students in following the learning process. This factor is supported by the research of Wardani & Utama (2015), which is one of the causes of low skills or problem-solving abilities, namely the presentation of learning in conventional ways such as lectures so that students are bored and less motivated in the learning process.

Related to educational innovation, it is greatly influenced by the development of the world of technology, the development of the world of technology affects all parts of life. This cannot be denied by anyone and from any circle, but in Indonesia technological development is still lagging behind compared to other countries. Indonesia's Information and Communications Technology (ICT) development lags behind other Group Twenty (G20) member countries. The index obtained by Indonesia in 2017 was 4.33 points. This figure is in the 114th position in the world or the second lowest in the G20 after India (Jayani, 2019).

The use of information and communication technology is a form of innovation in the world of education. In line with that, according to the 2019 Global Innovation Index (GII), Indonesia's innovation index has a score of 29.8 or ranks 85th out of 129 countries in the world (Jayani, 2020). In the Asean region, Indonesia's innovation ranking is in the second lowest position. GII is a benchmark used to assist policymakers in stimulating and measuring innovation activities. In addition, innovation is the driving force for a country's socio-economic development. Departing from this related to the development of Indonesian technology that is left behind and innovations that get a rating that is said to be quite unsatisfactory, this is very closely related to the world of education. Education plays an important role in this, the development of the mindset, the development of Indonesia starts from good education so that good human resources (HR) are created.

The role of education is very important in developing the ability and disposition to create students who are knowledgeable, faithful, moral, healthy, capable, creative, and independent. This is in line with the content of 21st century learning which emphasizes the ability to think critically, solve problems, be creative, innovative, communicative, and collaborative. Referring to these demands, mathematics lessons applied in schools should be able to answer the existing demands to present active, creative and innovative learning in the classroom so that it is hoped that it will be able to produce a generation that is ready to compete in global competition.

The implementation of active, creative and innovative learning is certainly a challenge for every educator. Changes in learning patterns are urgently needed to overcome these conditions. The learning pattern according to the opinion of Stigler, et al. in (Westwood, 2000: 4) is that during learning takes place students are not passive in receiving knowledge but students actively construct knowledge. Teachers provide the widest possible opportunity for students to develop their abilities by constructing the knowledge learned so that learning mathematics is the result of their own thinking and not the result of the practice process. In addition to changing learning patterns, the use of media in learning is very necessary. This is in line with the opinion of Pujiati & Hidayat (2015) that the use of media in the teaching and learning process has an important role. Media can help

students to more easily understand abstract mathematical concepts and increase students' motivation and interest in mathematics.

Media is a tool in the learning process that functions to clarify the meaning of the message conveyed so that learning goals can be achieved. Media contains messages as a learning stimulus and can foster learning motivation, so that students do not become bored in achieving predetermined learning goals. Along with the times, innovations in the use of learning media in the classroom have developed everywhere.

The lack of optimal problem-solving skills in students is based on research that has been conducted by previous researchers. The research conducted by Nasution (2018) said that students tend to memorize mathematical concepts, without understanding their purpose and content. And when learning, teachers tend to focus on achieving material targets according to the curriculum or textbooks used, not focused on understanding the material being studied. Nasution in his research explained the development of problem-based mathematics modules to improve students' mathematical problem-solving skills, getting results that problem-solving skills have improved. This can be seen from the percentage of classical completeness of students in the first trial of 81.25%, and the percentage of classical completeness of students in the second trial of 90.63%. Meanwhile, the results of the RPP validation by the expert team showed an average value above 4.3%, which stated that the research module was valid. Meanwhile, the validation of problem-based mathematics modules with an average of 4.2 is included in the valid category. For practicality, it gets an average score of more than 81% and the module can be said to be practical and worth using. Likewise, the intended effectiveness of the ideal time and the achievement of learning objectives with an average score of above 81% so that it meets the classical completeness criteria.

Not much different from the above opinion, Rahman (2018) said that students' failure in understanding mathematics was because students did not use reason in solving problems. But in his research, about the development of learning tools based on realistic approaches to improve problem-solving skills, there has been an increase, especially the topics discussed about problem solving. The increase in problem solving increased to 81.2 in trial II. The learning tool has been effectively used in learning which includes classical learning completeness, achievement of learning objectives and learning time. Not much different from other researchers, according to Kharisma and Asman (2018) said that students have not been thoroughly involved in learning that involves the presentation of problems by teachers, problem-solving demonstrations, and problems related to problem solving. So that knowledge, understanding and problem-solving skills are not well constructed. However, in his research, mathematical problem-solving ability was in the good category with a result of 72%.

Based on the needs analysis that has been carried out by the author at MTsN 1 Padang, the majority of students use smartphones with an android operating system. The questionnaire was distributed on the needs analysis, the researcher obtained information that students understood the main concept of the android operating system smartphone well, which was more than 70%. Students also understand well the benefits of android smartphones, which are more than 75%. In the results of the questionnaire analysis, it is also known that more than 80% of students have readiness to use Android-based operating system smartphones in learning. It can be seen that from the 25 students who attended out of a total of 30 students in grade VIII 5 admitted that they had used

smartphones, the intensity of Smartphone use from each student varied, from the use of Smartphones for less than 1 hour to more than 6 hours/day.

In carrying out the learning process, there are so many learning models that can be used, in this case the author chooses to use the Problem Based Learning learning model. Because the learning process starts from a problem and requires a problem solving. To be able to solve it. Supported by the opinion of Yuhani et al. (2018), the learning begins by providing problems and to solve them, students need new knowledge. In the study, the results were found that related to problem-solving skills, students who use the problem-based learning model are better. This is based on the average N-gain test with a value of 0.52.

When the learning process uses PBL, students will be given more problems that can be solved through discussion in class or solving them themselves. Research from Aisyah (2016) also wrote that problem-based learning is a learning model that exposes students to practical problems and can stimulate the occurrence of learning interactions in an active learning group.

Based on the description that has been explained, the problem formulation in this development research is what are the characteristics of problem-based learning-based digital teaching materials using android to improve students' valid, practical and effective mathematical problem solving? With the purpose of this development research, it is to produce learning media or digital teaching materials based on problem-based learning using android to improve students' valid, practical and effective mathematical problem solving.

## **METHODS**

The research procedure is guided by the design of the development of Plomp. Opinion (Sugiyono, 2015) states that the design and development research used aims to produce a certain product and test the effectiveness of the product. The development models studied by Plomp are the initial investigation phase, the development or prototype phase, and the research phase (Plomp & Nieveen, 2013). The subjects in the research on the development of PBL-based learning media using android are grade VIII MTsN 1 Padang students. Held from October 9 to October 21, 2023.

The instruments used in data collection in this study consist of several parts, namely: instruments in the initial investigation phase, instruments for validity tests, instruments for practicality tests, and instruments for effectiveness tests. Before conducting data analysis, first collect data instruments that will be analyzed by descriptive statistical analysis and qualitative analysis. Descriptive statistical analysis for quantitative data and qualitative analysis for qualitative data. The following data analysis techniques are used in the research: validity analysis, practicality data analysis, effectiveness data analysis.

## **RESULT AND DISCUSSION**

The results of this study are explained based on the activities carried out during the research process, namely the development of learning media based on the problem based learning model assisted by android to improve the mathematical problem-solving ability of grade VIII students. The research process consists of three phases, namely Preliminary Research, Development Or Prototyping Phase and Assessment Phase.

### **Results Of The Initial Investigation Stage**

Activities at the initial investigation stage start from needs analysis, curriculum analysis, concept analysis and student analysis. The analysis that has been obtained is explained as follows. Needs analysis activities, the researcher carried out several activities such as observation and interviews with mathematics teachers and students. In addition, the researcher also gave a questionnaire to students. Based on the needs analysis activities that have been carried out, information is obtained that students have mathematical problem-solving skills that are still relatively low. Students also find it difficult if they are given practice questions that are different from the examples of questions that have been given. When the teacher gives questions related to daily life, there are still many students who are not able to do the problems, only a few students can do it. So to solve the problem, the teacher needs to re-explain on the board. The teacher also revealed that the attitude of grade VIII students is still rarely reading, asking if there is material that is not understood, still lacking independence in the mathematics learning process because it still depends on explanations from the teacher, lack of thoroughness in doing exercises and there are students who are dishonest such as looking at friends' assignments and not collecting assignments on time.

This curriculum analysis was carried out by examining the curriculum used in junior high schools. The curriculum analysis was carried out to see the suitability of Core Competencies (KI) and Basic Competencies (KD), Competency Achievement Indicators (GPA) and learning objectives in mathematics materials in junior high schools/MTs. Based on the Minister of Education and Culture Regulation No. 21 of 2016 concerning junior high school mathematics content standards. The results of this curriculum analysis are needed so that the digital teaching materials developed are in accordance with the competency demands that must be achieved by students. So that digital teaching materials can be used optimally by teachers and students.

Concept analysis aims to identify the main concepts taught, detail and organize them systematically according to the order in which they are presented. This concept analysis also aims to determine the content and subject matter needed in the development of android-assisted problem-based learning digital teaching materials.

The student analysis was carried out to find out the characteristics of the students so that the media design to be developed was in accordance with expectations in the mathematics learning process in MTsN 1 Padang grade VIII. This analysis is necessary before designing a learning tool. Based on the results of interviews with teachers, it was obtained that students in one class have various academic abilities consisting of high, medium and low abilities, this is also corroborated by the teacher's statement that due to the zoning system of a school there is now no superior school, all classes are the same and the class formed does not have a superior class, students in an average class, have high, medium and low ability students.

### **Results Of The Development Stage**

As a result of the preliminary research, a learning tool was designed in the form of lesson plans and android-assisted problem-based learning teaching materials for junior high school/MTs grade VIII semester I mathematics materials. The Problem Based Learning Implementation Plan (RPP) is a learning tool designed specifically for junior high school/MTs grade VIII students. The characteristics of the PBL-based lesson plan that is designed can be seen in the following components: Identity of the lesson plan, Core Competencies, Basic Competencies, Indicators of

Achievement of Competencies and Learning Objectives, Teaching Materials, Approaches, and Learning Methods, as well as tools, media and learning resources.

Android-assisted PBL-based digital teaching materials are designed based on basic competencies and mathematical learning needs at MTsN 1 Padang so that learning goals can be achieved optimally. Android-assisted teaching materials are equipped with covers, main menus, main menus on Relationships and Functions materials, and so on. The following is a description of the initial design of android-assisted teaching materials such as: cover, menu of materials about relationships and functions and exercises.

The results of the design of PBL-based teaching materials in the early stages are called prototype 1. To obtain a valid device, the validation stage is then carried out. There are two steps taken in validating, namely self-evaluation and assessment by experts. The following is a description of the results of the validation of the teaching materials that have been designed.

The results of the design of android-assisted PBL-based digital teaching materials were evaluated by themselves before being submitted to experts. The evaluation was carried out to double-check typographical errors, the use of punctuation in sentences, the clarity of the images used, the suitability of the material, the suitability of the images to the problem, the order of activities, the suitability of the problems listed in the teaching materials, and the questions in the exercise,

PBL-based digital teaching materials assisted by problem-based learning have been designed and validated by experts (validators). Validators are people who are competent in the preparation of lesson plans and mathematics teaching materials and are able to provide input to improve the mathematics teaching materials that have been prepared. The suggestions from the validators will be used as material to revise the teaching materials that have been designed. This stage is to produce valid or very valid teaching materials.

The validators in this study consisted of five validators consisting of 3 lecturers in mathematics education, 1 lecturer in educational technology and 1 lecturer in linguistics. Based on the assessment instrument in the form of a teaching material validation sheet, it is divided into three aspects, namely material validation sheets, graphics and language. The validity test starts from the validity test of the mathematical material, then the graph validity test and the language validity test. The following are the results of the validation of lesson plans and teaching materials based on android-assisted problem-based learning.

Table 1. Validation Results of Problem Based Learning RPP with Android Assistance by Expert Review

No	Aspects assessed	Validity Index	category
1	Serving	3,5	Valid
2	Assessment Aspects	3,5	Valid
3	Language	3	Valid
	Total Average	3,33	Valid

The validation results based on table 1 can be concluded that the problem-based learning RPP assisted by android is 3.33 with a valid category. The validation of android-assisted problem-based learning interactive learning media was carried out in conjunction with the RPP validation activity. The validation of interactive learning media was validated by 5 experts. The results of the validation of android-assisted problem-based learning interactive learning media can be seen in Table 2 below.

Table 2. Results of Validation of Teaching Materials Problem based learning assisted by android by

Expert Review

No	Aspects assessed	Validity Index	Category
1	Test the validity of mathematical material	3,42	Very valid
2	Test the validity of language material	3,75	Very valid
3	Test the validity of graphic material	3,2	Valid
	Average validity index	3,46	Very valid

The validation results based on Table 2 obtained the average validity index of android-assisted teaching materials is 3.46 with a very valid category.

The results of the validity test of the teaching materials are declared valid or very valid by the validator in prototype 1, then the next stage is prototype 2. Furthermore, the teaching materials were tested on 3 students in grade VIII who had different abilities, namely one person with high ability, one person with medium ability and one person with low ability. The results show that Android-assisted PBL-based teaching materials are easy to understand even though there are slight improvements. Through interview activities, it was also obtained that the presentation of android-assisted PBL-based teaching materials can be understood by students, both instructions in the media, images, and the context of problems related to daily life can be said to be practical.

Teaching materials that have been revised based on suggestions and criticism at the one-to-one evaluation stage, will then be tested in small groups (small group evaluation). The teaching materials were tested on 6 grade VIII students who had different abilities, namely two people with high ability, 2 people with medium abilities and 2 people with low abilities. The six students were different students at the one-to-one evaluation stage. Students will be divided into two groups, with each group consisting of 3 students with different abilities. Students who have completed the evaluation of small group on PBL-based teaching materials as many as 5 meetings. It can be seen that the development of students' mathematical problem-solving skills tends to increase.

Students who have finished doing the exercises contained in the worksheet are then interviewed and fill out the practicality sheet of the teaching materials (student responses), as well as the teacher's response to assess the practicality of the PBL-based teaching materials. The following are the results of filling out the practicality sheet of teaching materials (teacher's response).

Table 3. Teacher Response Scores and Categories

No	Aspects assessed	Score	Cetegory
1	Attraction	91,67	Very Practical
2	Usage Process	83,33	Very Practical
3	Ease of Use	83,33	Very Practical
4	Time	75	Practical
5	Equivalence	91,67	Very Practical
	Average	85%	Very Practical

The results of filling out the practicality sheet of digital teaching materials (educator response) showed that the revised teaching materials received an average score of 85%. This score falls under the "very practical" criteria. According to the teacher who teaches mathematics at SMP 2 Bonjol, the teaching materials can be used very well and are easy to use. The following are the results of filling out the practicality sheet of teaching materials (student responses).

Table 4. Scores and Categories of Practicality of Student Responses in Small Groups

No	Aspects assessed	Score	Category
1	Serving	90	Very Practical
2	Usage Process	89,28	Very Practical
3	Ease of Use	100	Very Practical
4	Time	75	Praktis
	Equivalence	88,57%	Very Practical

The results of filling out the teaching material practicality sheet (student response) showed that the revised teaching materials received an average score of 88.57%. This score is included in the very practical criteria.

The effectiveness test in the small group was carried out to see an improvement in students' mathematical problem-solving skills. The test is an instrument for achieving competence in statistical material and related questions about mathematical problem-solving skills. The results of the mathematical problem-solving ability test in small groups can be seen in the following table:

Table 5. Results of the Mathematical Problem-Solving Ability Test in Small Group Evaluation

Student Categories	KKM	Test results	Information
SKT -1 (high)	78	85	Pass
SKT -2	78	86	Pass
SKS -1 (keep)	78	81	Pass
SKS -2	78	80	Pass
SKR -1 (rendah)	78	78	Pass
SKR -2	78	76	Not Passing
Persentase		81%	

Table 5 shows that out of six people who took the test in the small group, there was 1 person who did not complete. The percentage of learning completeness in the small group obtained in the table above is 81%. It was concluded that learning using PBL-based teaching materials had an effect on improving students' mathematical problem-solving skills, and was effective.

## DISCUSSION

Based on the comprehensive research process and the results obtained, several key findings emerge. Firstly, the initial investigation highlighted significant challenges in students' mathematical problem-solving skills, revealing a need for tailored educational interventions. The development phase then led to the creation of Android-assisted problem-based learning (PBL) teaching materials, meticulously designed to address these challenges. Through rigorous validation by both self-evaluation and expert assessment, the materials were refined to ensure alignment with educational standards and pedagogical effectiveness.

The validation process, involving mathematics educators and experts in instructional design, affirmed the robustness of the Android-assisted PBL materials. These validations underscored their suitability in enhancing learning experiences and promoting deeper engagement with mathematical concepts among grade VIII students. Moreover, small-group evaluations demonstrated a positive impact on students' problem-solving abilities, reflected in notable improvements across diverse academic abilities. The practicality assessments from both teachers and students consistently rated the materials as highly effective, affirming their usability and instructional value in real-world classroom settings.

This research not only substantiates the efficacy of integrating technology-enhanced PBL in mathematics education but also underscores its potential to foster critical thinking and independent learning skills among students. The findings suggest that such innovative approaches can effectively address educational challenges and enhance learning outcomes in secondary education contexts.

## CONCLUSION

Based on the process and results of the research, the following conclusions were obtained: The results of the study show that android-assisted problem-based learning media to improve mathematical problem-solving skills has met valid criteria in terms of content and construction. The teaching materials developed are in accordance with the subject syllabus and curriculum content.

The results of the study show that android-assisted problem-based learning media to improve the mathematical problem-solving ability developed has met practical criteria both in terms of implementation, convenience and time required. This can be seen from empirical data, namely practicality questionnaire data according to students and teachers.

The results of the study show that the android-assisted problem-based learning media to improve students' mathematical problem-solving skills has been effective as seen from empirical data, namely from the final test trial of student problem-solving skills from 29 students in grade VIII.8 there were 24 students who completed (82.75% complete), while 5 students were incomplete (17.24% incomplete). Android-assisted problem-based learning media to improve mathematical problem-solving skills is a teaching material that can direct students and teachers to construct their knowledge so that they can improve their problem-solving skills and make student-centered learning in accordance with the 2013 curriculum.

## CONFLICTS OF INTEREST STATEMENT

Regarding this study, the author declares that there is no conflict of interest.

## AUTHOR CONTRIBUTIONS

Study concept and design: As Bintang. Acquisition of data: Ali Asmar. Analysis and interpretation of data: I Made Arnawa. Drafting the manuscript: As Bintang. Critical revision of the manuscript for important intellectual content: Edwin Musdi. Statistical analysis: As Bintang.

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