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# The problem solving ability of 7th grade students on problem based learning assisted by mathematics mobile learning application

Fitrah Adindaru Santoso*, Edy Soedjoko

*Department of Mathematics, Faculty of Mathematics and Natural Science, Semarang State University, Indonesia*

** E-mail address: Fitrahadindaru@students.unnes.ac.id*

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Abstract

Developments in mobile technology and mobile phone have significantly improved. Learning using multimedia and networking becomes a mindset that must be applied. The low level of problem solving abilities of students requires educators to apply new approaches on learning. For this reason, this research aims to develop and determine the feasibility of android product based mobile learning application on Problem Based Learning and investigate individual completeness and classical completeness on students' problem solving abilities on Problem Based Learning assisted by Mathematics Mobile Learning Application. This research used the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). The technique of collecting data uses tests, questionnaires, documentation, observation. The technique of analysis data uses a Likert scale, average test, and proportion test. The product of application was tested on 4 groups of respondents according to the research flow, namely material experts, media experts, teachers, and students of Junior high school 16 Semarang. The android-app products are named learning rectangle. Results 1) Based on the research that has been carried out, mobile learning applications have been developed to support mathematics learning in square and rectangular sub-material for junior high school students. This application is named Learning Rectangle which can be run on an Android smartphone. After going through the feasibility test phase, learning rectangle application is worthy of being used as a support for mathematics learning in square and rectangular sub-material for junior high school students with a percentage of eligibility of 93,68% and included in the criteria of very feasible. 2) Problem solving ability of 7th Grade Students in quadrilateral with rectangular and square sub-material in the PBL model Assisted by MMLA reached the learning completeness criteria. 3) Students' responses to the application have a positive effect on students' problem solving abilities in PBL assisted by MMLA, with a determination coefficient of 0,132 or an influence of 13,2% on students' problem solving abilities



## 1. Introduction

Today, Indonesia's quality of education is expected to improve. One of the important things in improving the quality of education is the learning process. Based on Constitution Number 20 of 2003 about national education system, learning is the process of student interaction with educational resources learning in a learning environment.

Mathematics is a very important subject. Therefore, mathematics is used as a mandatory subject in elementary and middle school level in education system in Indonesia. Based on Minister of Education Regulation number 21 of 2016 about the standard content of primary and secondary education stated that students have the competence to demonstrate attitude, logical, critical, analytical, creative, careful, and thorough, responsible, responsive, and not easy to give up in Solve the problem. The National Council of Teachers of Mathematics (2000) establishes a process standard for mathematics learning in schools, which are five abilities students must master in mathematics learning. These capabilities include: (1) Problem solving capability (problem solving), (2)

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Reasoning ability and proof (reasoning and Evidence), (3) Communication skills of mathematics (communication), (4) Mathematical connection capability (connections), and (5) The ability of mathematical representation (representation).

According to Dwijayanti in Yoselin (2016) Everyone will always be faced with problems in their life, because it is very important for everyone including students to learn problem solving. According to Suherman (Amalludin, 2016) problem solving is part of the mathematical curriculum, in the learning process students are possible to gain experience using the knowledge and skills already possessed to be applied to Problems that are not routine. However, students ' problem solving skills in Indonesia are still weak especially in quadrilous matter. This is demonstrated by the National Education Standards Agency data related to the state exam results of the year 2017/2018, especially in SMPN 16 Semarang, as well as the following cities, and national countries

**Table 1.** National Test Absorbent Power of 2017/2018 SMPN 16 Semarang.

| Tested Capabilities | School | City | National |
|---|---|---|---|
| Specifies the length and width of the rectangle | 51,91 | 41,15 | 35,54 |
| Determining the Combined circumference of two tires | 66,03 | 49,74 | 37,85 |

From table 1, it can be seen that the absorption of the rectangular material in SMPN 16 Semarang has not fulfilled the classical KKM on 75. Therefore, this research focuses on square and rectangular material.

Based on observations conducted by researchers when conducting field experience practice at SMPN 16 Semarang in August-October 2018, during a learning activity takes place when the teacher asks students to argue about Material, only a few students dare to express his opinion. It is likely that some of the other students are still not confident because they are afraid to argue and there is also a possibility that there is no understanding of the material being taught. From the results of the interview with the teacher of class VII Mathematics SMPN 16 Semarang in February 2019, it is known that the student problem solving skills in rectangular material are still lacking. Rectangular material is one of the material taught at the first high school level. Rectangular material is one of the aspects that are tested in SMP Mathematics national exam. Based on the interview, in answering the question of rectangular material, students can only answer in terms of calculations using formula only. When students are faced with contextual issues, students begin to find difficulties in how to resolve the issue. So it appears that students' problem solving skills are still relatively low.

In order to be more well-trained mathematical problem-solving skills, there is a need for innovations in classroom mathematics learning that is a learning model implementation that can hone students' problem-solving skills. One of the learning models that can increase the skills of mathematical problem-solving is the Problem Based Learning model. The Model Problem Based Learning (PBL) According to Barrows, as quoted by Barrett (2010) states “The PBL is the learning that results from the process of working towards the understanding of a resolution of a Problem. The problem is ecountered first in the learning process". This learning Model confronts students in a problem so that students can develop high-level thinking and problem-solving skills and acquire new knowledge related to the problem (Lestari, 2017). According to Oguz-Unver & Arabacioglu (Lestanti, 2016), the main principle of Problem Based Learning is to maximize learning by investigating, explaining, and resolving contextual and meaningful problems.

The Problem Based Learning Model can develop new knowledge from learners. However, the model still has weaknesses. According to Sanjaya (2014) The weakness of Problem Based Learning is that it takes a long time compared to other models of learning and if learners have no interest then they will feel reluctant to give it a try. Therefore, it takes effort to improve the learning on this model.

Based on Minister of Education Regulation Number 68 of 2013 about the completion of the mindset developed in the 2013 curriculum stated that 1) pattern of isolated learning into networked learning (learners can draw knowledge from anyone and from anywhere That can be contacted and acquired over the Internet) 2) Single-tool learning pattern into multimedia-based learning tools. Mathematics Mobile Learning Application (MMLA) is a blend or combination of E-Learning

and Mobile Computing that can access a learning application anytime and anywhere (Hendri, 2015). The latest developments in mobile technology are increasingly making it possible to support mobile learning and utilize this spontaneous learning situation. In addition, mobile technology offers a new opportunity to integrate spontaneous learning in more formal learning scenarios. It is supported by Cisco (Cahyono, 2018) stating "Developments in mobile technology and mobile phone have significantly improved".

According to Borba (2016) in his research stated "The use of mobile technologies (such as smartphones and tablets) in The teaching and learning of mathematics is gaining a growing interest among educational researchers and practitioners. The characteristics of mobile devices such as portability, availability, access to the Internet, and its wide acceptance among young people and others, have made mobile devices an emerging agent capable of expanding the frontiers of mathematics instruction and Learning beyond the walls of the classroom ". This potential is what makes MMLA can be applied in the implementation of learning activities.

Based on observations and interviews conducted at SMP Negeri 16 Semarang, there is information that students of SMP Negeri 16 Semarang are allowed to bring a mobile phone with a note deposited to the teachers during the learning activities. Most students reside in place that does not pass public transport. Therefore, students are allowed to bring a mobile phone to order a Gojek and notify parents to be picked up. When at home, most students use their mobile phones to play games and social. Therefore, an innovation is needed for technology utilization can be used also in education.

Based on the above exposure, this study raised the Mathematics Mobile Learning Application (MMLA), which is learning using gadget or mobile phone to make learning in Problem Based Learning more efficient and increase interest Learners. Researchers are interested in conducting application development and research in order to optimize the success of mathematical learning especially in rectangular material by implementing or implementing the study of the PBL assisted MMLA in Influence of student mathematical problem solving skills.

Based on the description, researchers conducted a study titled "Ability to troubleshoot students of class VII on Problem Based Learning assisted Mathematics Mobile Learning Application".

Based on the background described above, the issue that will be examined in this study is as follows 1) how is the development and feasibility of Android-based mobile learning applications on Problem Based Learning? 2) Is the problem solving ability of students through the Mathematical Problem-Based Learning Model Mobile Learning Application can achieve learning completeness? 3) Is the student's response to the application in Problem Based Learning assisted by Mathematics Mobile Learning Application has a positive effect on students' problem solving abilities?

Based on the formulation of the problems that have been raised above, the objectives of this research are as follows. 1) Develop and know Android-based mobile learning app on Problem Based Learning. 2) To find out students' problem solving abilities through a Problem-Based Learning assisted by Mathematics Mobile Learning Application can achieve learning completeness. 3) To find out whether students 'responses to the application in Problem Based Learning assisted by Mathematics Mobile Learning Applications have a positive effect on students' problem solving abilities.

## 2. Methods

Researchers use the research type of Design Research. Design Research is also known as developmental research or development research. The intended research is to produce a particular product (Sugiyono, 2017). The development model used in this research is the ADDIE Model. ADDIE is an acronym for Analyze, Design, Develop, Implement, and Evaluate. Branch (2009), revealed that product development using the ADDIE process is a very effective tool, because ADDIE is merely a process that presents a framework of guidelines for complex situations.

The subject in this research is an Android application that used to support the mathematical learning of geometry material for junior high school students. The selected material is rectangular and rectangular sub-material. The object in this research is the feasibility of an application created. Application eligibility tests are based on predefined criteria. Respondents in the research were divided into: media experts, material experts, teachers, and students. Recruitment of students in research using the purposive system,

namely the determination of respondents with certain considerations (Lestari, 2015). This purposive system is used with the assessment of researchers to determine which is the best one to be a research respondent.

In this research, product valuation criteria set on mobile applications were in terms of software engineering aspects, learning design aspects, and visual communication aspects. The methods used in this research are the Observation, tests, questionnaires/polls, and documents. Observation is used to observe how school conditions, learning activities, especially mathematics, student conditions, and curriculum, and know the ability of students in mathematics learning. This written test is given to students that researchers get data that can be used to determine the extent to which the students' mathematical problem solving skills solve the problem. The questionnaire/poll method was done to measure the quality of the media assessed by the respondent. This questionnaire is given to media experts, material experts, teachers, and students. The documentation in this researcj is the archiving of files that support the research.

Data analysis using the results of the questionnaire and test the ability of students mathematical problems to be conducted due diligence, test normality, average test, proportion test, and regression test.

## 3. Results & Discussions

This research produced a product in the form of an Android-app based mathematics learning for seventh grade junior high school students on rectangular material. The development is carried out with the ADDIE model as follows:

### *3.1. Analysis*

The Analysis is to maximize the function of learning media to be created. To maximize the results of the products to be made there are several aspects to consider, that is:

#### *3.1.1. User*

The target users of the mobile learning application development were seventh grade junior high school students. The results of preliminary interviews with a several students in junior high school showed that they used mobile phones (smartphones) only to play games and social media while at home and use smartphones in schools to order motorbikes online when leaving and returning home. From observations made by researchers in class VII E obtained data that 27 of 32 students have an Android smartphone. This has become a great potential and opportunity for the development of mobile learning applications with the Android operating system.

#### *3.1.2. Content Needs*

The content is material. The material presented in the mobile learning application to be developed is square and rectangular according to the 2013 junior high school curriculum.

#### *3.1.3. Interface Design Needs*

One of the advantages of learning media or learning resources based on mobile devices is on the design interface aspect. This display design influences how students interest to better understand the material. In developing this mobile learning application, a simple and cheerful theme will be used that will make users feel comfortable. For the font type to be used is the Comic Sans MS font and the default font from the software to create the application. The type and size of this font can be read clearly and does not make users feel bored. In addition, the use of images related to the material is also felt to provide a special attraction for the user.

#### *3.1.4. Software Requirements*

Researchers use MIT App Inventor as this application development software. MIT App Inventor is considered to be the right software because it supports displaying text, images and videos.

### *3.2. Design*

Preparation of learning media design The learning media developed is a type of supporting media in learning. This was chosen to optimize the use of applications in the learning process. The design of learning media produces a flowchart. This application is named "Smarthematics".

### *3.3. Development*

The development stage is the stage of making a mobile learning application. In making this application of course adapted to the design that has been designed. The first thing to do in making an application is to collect materials that will be used to fill the application content, namely material, images, videos, icons, sounds. Square and rectangular materials are prepared based on the 2013 curriculum. From the results of the needs analysis, the material is arranged in two material,

namely square and rectangle which are related to understanding, characteristics, perimeter, and area.

This application starts with a simple intro in the form of a loading animation of around 3 seconds along with the words "Loading" below which indicates the application is ready to run. The application's main menu page has six menu icons namely Material, Exercise, Online, scan smart, about, and exit. The intro page and main menu are shown in figure 1.

a b

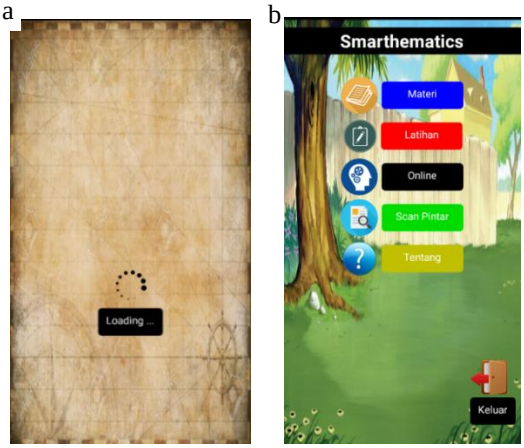


**Figure 1.** (a) Intro page; (b) Main menu.

The Materials menu contains a summary of square and rectangular material and the home button to return to the main Menu page. The material can be removed and re-displayed at any time by the developer through Googlesite in accordance with the needs, if in the learning of students to construct their own experiences then the display of material can be raised as a summary of the material After learning.

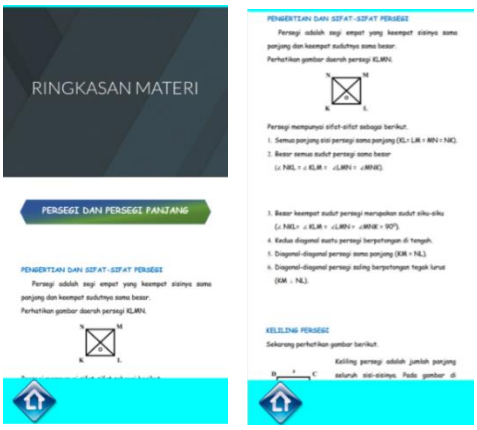


**Figure 2.** The Material menu display

The Exercise menu is presented 5 questions that correspond to the subject matter and are accompanied by a final score as an assessment. When the user opens the first page in the Training menu, it will be shown by default to the number 1. After students choose their answers between options A, B, C, and D, it will automatically be displayed as a matter of number 2. In the same way, about numbers 3, 4, and 5 will be displayed after students have chosen their answers. After finishing the problem number 5 will be shown the final score result of the student exercise. The practice page is shown in Figure 3.

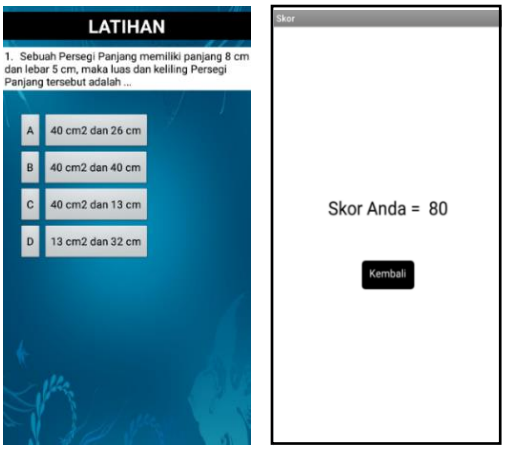


**Figure 3.** Practice Menu Display

Online is a menu that contains a home button and a sub-menu button consisting of sub-menus PPT, videos, quizzes, and tests. Online menu must be connected to the Internet because it is connected with googlesite which is used as the menu screen so that the content in this menu can be updated without having to reinstall the application. The online menu page is shown in Figure 4.


**Figure 4.** Online Menu Display

On the PPT menu will be shown two buttons to open material PowerPoint as well as Back button and home button. The button to open the

PowerPoint is the PPT button 1 and PPT button 2. The 1 PPT button will display a PowerPoint with square material while the PPT 2 button will display a PowerPoint with rectangular material. The Back button is used to return to the online menu page while the home button is used to return to the main menu. The PPT menu page is shown in Figure 5.

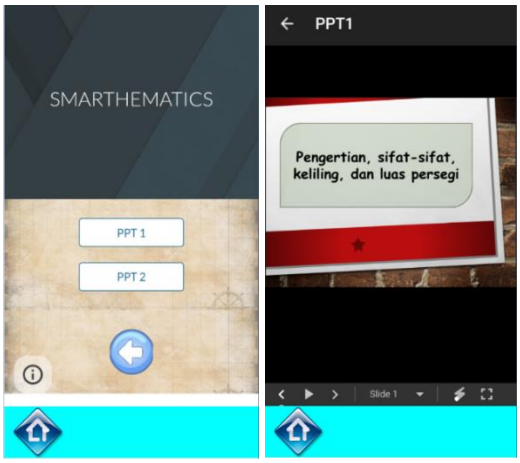


**Figure 5.** PPT Menu Display

The Video Menu contains eight buttons for unlocking 8 math learning simulation videos as well as one home button at the bottom left corner. The keys and videos are the properties of square 1, the nature of Square 2, the nature of square 3, the nature of Square 4, the circumference of the square, the square area, the properties of rectangles, and the area of the rectangle. The Video menu page is shown in Figure 6.

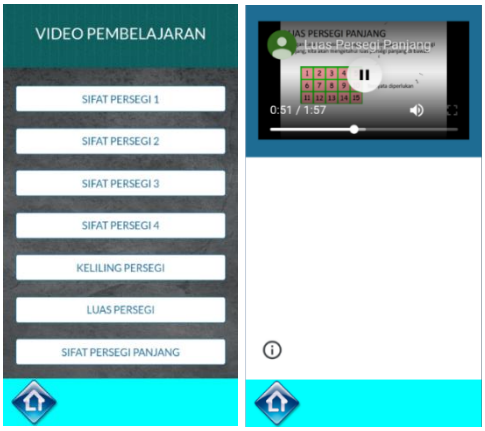


**Figure 6.** Video Menu Display

The quiz Menu contains 1 quiz button, 2 quiz buttons, Back button, and home button. This Menu will connect with Googleform which contains a set of short stuffing questions that can be done by the user. If the user fills the answer on the form and is worth it, it will show the "wrong answer" on the bottom and a red background for the user to know that the answer they get is wrong. If the user fills the answer correctly then there is no wrong answer and white background. After students can work on the whole question correctly, students can send their answers. The quiz menu page is shown in Figure 7.

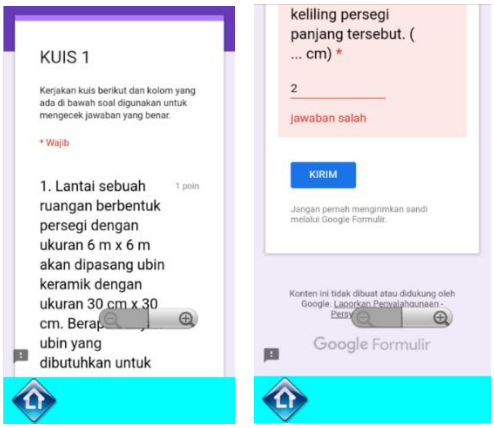


**Figure 7.** Quiz Menu Display

The test Menu will display the Test Start page to fill in the student identity. After the student has filled in identity and a stretch, it will display a page to work on multiple choice questions and time constraints for 20 minutes. The results will be sent and assessed. Students can post the results of their work even though time remains. Next will be shown the ability test scoring page as well as buttons to display the discussion of the questions that have been done. The test page is shown in Figure 8.

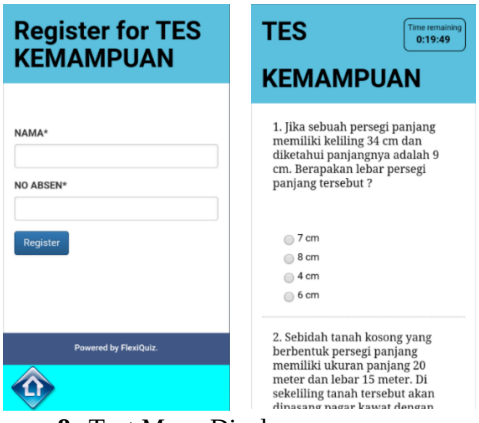


**Figure 8.** Test Menu Display

The Smart Scan is the menu used to scan the barcode which will then connect to the Internet link. This menu has a scan button above that is connected to the smartphone camera to scan the barcode supported by this menu. This Barcode will

be combined with student worksheets (LKPD) to display illustrations related to material that is not enough just by using LKPD. In addition, this menu can be used to add insight into students who have not yet existed in the textbook. The Smart Scan page is shown in Figure 9.

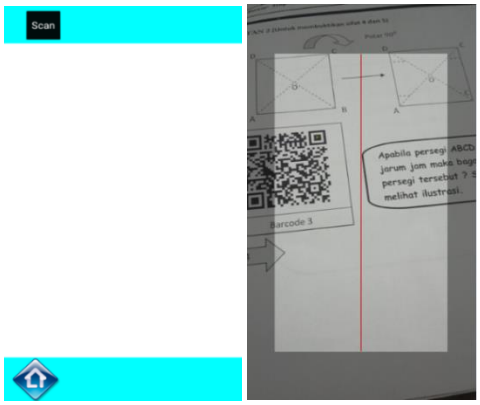


**Figure 9.** Scan Menu Display

The about contains two sub-menus namely application and about menu of applications. The application Menu contains descriptions of Smarthematics, biodata developers, and the origin of the developer agencies. In the about menu of application contains explanations related to the menu in the main menu.


**Figure 10.** About Menu Display

*3.4. Implementation*

The implementation phase contains a trial of the product that has been developed to the respondents. This research used 4 groups of respondents, namely media experts, material experts, teachers and students. The four respondents had their respective roles in providing an assessment of the feasibility of the application.

The first event was to test the application to the media experts on development, design, and features included in the application on March 6, 2019 by providing an application assessment poll. Further testing applications on material experts related to material content and writing in applications on March 8, 2019 by filling the assessment on the application Assessment questionnaire. To test the application's assessment to the teacher of the study by filling the questionnaire on March 16, 2019.

The next activity is testing the application in a small group of 5 students of SMP Negeri 16 Semarang After returning school on 16 March 2019. In the last Test the app is collaborated with learning in the classroom. The learning activities were conducted on 19 March – 2 April 2019. The learning performed in the experimental class is learning by using the Problem Based learers learning model. Learning is done during 4 meetings. The material taught in this learning is square and rectangular. The use of gadgets is collaborated with LKPD to help students understand the concepts being taught.

*3.5. Evaluation*

Evaluation is conducted in order to conduct an assessment of the application on learning Problem Based Learning. In this research will analyze students' problem solving skills as well as the analysis of application feasibility assessment of respondents divided into 3 aspects, namely, software, learning design, and visual communication. The following table 2 is an assessment software aspect.

**Table 2.** Assessment of software aspects

| Respondent | Score | Percentage | Criteria |
|---|---|---|---|
| Media Expert | 4,90 | 98,00% | Very Feasible |
| Teacher | 4,33 | 86,67% | Very Feasible |
| Students | 4,51 | 90,28% | Very Feasible |

Based on table 2 then the percentage of software aspect is 94,84% and belongs to very decent category. The following table 3 is an assessment of learning design aspect.

**Table 3.** Assessment of Learning Design Aspect

| Respondent | Score | Percentage | Criteria |
|---|---|---|---|
| Material Expert | 4,60 | 92,00% | Very Feasible |
| Teacher | 4,45 | 89,09% | Very Feasible |
| Students | 4,56 | 91,17% | Very Feasible |

Based on table 3 The Learning design aspect percentage is 89,37% and belongs to the category very decent. The following table 4 is an assessment of visual communication aspect.

**Table 4.** Assessment of visual communication aspects

| Respondent | Score | Percentage | Criteria |
|---|---|---|---|
| Media Expert | 5,00 | 100,00% | Very Feasible |
| Teacher | 4,80 | 96,00% | Very Feasible |
| Students | 4,73 | 94,53% | Very Feasible |

Based on table 4 the percentage of the visual communication aspect is 96,82% and belongs to the category very decent. Thus, the average aspect of the quality of learning media is 93,68% and includes very decent criteria.

Based on the analysis of test data students' problem solving skills are obtained that the data is distribution normally. Students ' troubleshooting Data is obtained based on test scores of student problem-solving skills.

The hypothesis 1 test was conducted to determine if the problem of grade VII students in Problem Based Learning assisted by the Mathematics Mobile Learning Application reached individual. Next to test the hypothesis 1 is conducted one-party test (right) with the criterion of the submission is 71. Based on the $T$ test calculation, the value obtained is $T_{\text{hitung}}$ = 2,451 and $T_{\text{tabel}}$ = 1,695. Because $T_{\text{hitung}}$ = 2,451 > 1,695 = $T_{\text{tabel}}$ then $H_0$ is rejected and $H_1$ is accepted, meaning that the average posttest value of mathematical problem solving skills of students who are using the Problem Based Learning assisted by MMLA achieves a minimum of the average determination of 71.

Hypothesis 2 in this research is to determine whether the problem solving abilities of class VII students in PBL Assisted by MMLA reach the minimum completeness criteria classically which is equal to ≥ 75% of the students who get a minimum value of 71. Test of the hypothesis 2 proportioning uses z test. From the results of calculations obtained $z = 0{,}408$ while with $\alpha = 0{,}05$ obtained $z_{\text{table}} = -1{,}64$. Because $z > -z_{table}$, then $H_0$ is accepted. Means the problem solving ability of seventh grade students in quadrilateral with rectangular and square sub-material in the model of Problem Based Learning Assisted by Mathematics Mobile Learning Application reaches classical completeness criteria.

Hypothesis 3 in this study to determine whether students 'responses to applications in PBL assisted by MMLA have a positive effect on students' problem solving abilities. Based on the results of the regression analysis using SPSS 18.0 the regression equation was obtained. From the results of the analysis, it was obtained the fact that students 'responses to the application had a positive influence on students' problem solving abilities in the PBL assisted by MMLA of 13,2%.

From the results of testing the application, to increase the selling value of application products, media experts suggest to improve the name that is more easily recognized by the public. For this reason, the name Smarthematics that is too unfamiliar is changed to learning rectangle.

## 4. Conclusion

Based on results and research discussion obtained conclusion:1) Based on the research that has been carried out, mobile learning applications have been developed to support mathematics learning in square and rectangular sub-material for junior high school students. This application is named Learning Rectangle which can be run on an Android smartphone. After going through the feasibility test phase, learning rectangle application is worthy of being used as a support for mathematics learning in square and rectangular sub-material for junior high school students with a percentage of eligibility of 93,68% and included in the criteria of very feasible. 2) Problem solving ability of 7$^{th}$ Grade Students in quadrilateral with rectangular and square sub-material in the PBL model Assisted by MMLA reached the learning completeness criteria. 3) Students' responses to the application have a positive effect on students' problem solving abilities in PBL assisted by MMLA, with a determination coefficient of 0,132

or an influence of 13,2% on students' problem solving abilities.

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