E-book Based on Mobile Learning Used Problem Based Learning (PBL) Model to Improve Problem-Solving Ability in Statistical Material

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Abstract. The research aims to developed a mobile learning-based e-book that used problem-based learning (PBL) to improve problem-solving abilities in statistical materials that meets validity, practically, and effectiveness. The type is a Development Research used the Four-D model (define, design, development, and disseminate). The validation results of the material feasibility average was very good at 82% and the validation of the media was 85.92%. The results of the response questionnaire by students was 88.22% and by the teacher was 83.31%, included in the very practical category. Therefore the mobile learning-based e-book developed is valid to use in mathematics classes. The result of e-book effectiveness meets the effective criteria with the completeness study of students at 84%. From the products tested, it was concluded that the students problem-solving abilities in statistics material used mobile learning-based e-book that had been developed were better than used existing products. Thus, this mobile learning-based e-book used a problem-based learning model to improve problem-solving abilities in eighth grade of statistical material which is suitable for uses and recommended at mathematics learning.

1. Introduction
The development of a nation cannot be separated from the role of education on it [1]. Through education, a nation could face global competition in this era. In this era, many countries have been influenced by the development of science, so that by having good educational qualifications people can get a bigger chance to get a good job [2].

One of the compulsory subjects in formal education that can solve the various problems is mathematics [3]. Mathematics also has a very important role in various other sciences and also in human life [1]. NCTM was formulates five mathematics learning objectives, one of that’s objectives is to improve the ability to solve mathematical problems. So, the ability to solve problem become abilities that needs to be taught properly in schools [4].

In learning activities, problem-solving abilities have an important and influential role for students [5]. The ability to solve mathematics problems needs to be given and accustomed to students as early as possible. Problem solving abilities can help to solve problem experienced by students in their daily lives [6]. Problem solving abilities are important to be given to students because: a) it can help develop cognitive abilities in general, b) problem-solving help students to develop creative thinking, c) it is a part of the mathematical process, and d) can motivate students to study mathematics.

However, based on the reality in the field, mathematics is still the subject most avoided by students. Many students have difficulty learning mathematics, especially in solving math problems.
This is also influenced by the number of students who think mathematics is not an interesting subject, so that students difficult to accept by students [7]. Mathematics learning outcomes are also still lower when compared to learning outcomes of other materials.

The results of researchers’ observations based on the 2018/2019 Indonesian national exam show that the results of mathematics absorption in Madiun district are only 48.4%, still below the national minimum standard of 55.0%. This is also supported by the results of observations and interviews with teachers in schools that students' interest in mathematics is still low and students have difficulty working on questions that require non-routine completion procedures. Written tests were also conducted to analyze the problem-solving abilities of three students with different ability levels. However, after the analysis was carried out, it can be said that many students experienced difficulties in solving problems, especially in the form of questions that were rarely encountered.

Mathematics teaching materials used today also make students uninterested and bored because the delivery technique of the material in teaching materials is relatively one-way and less interactive for students. The results of observations and interviews with representatives of the Mathematics teacher council in Madiun Regency, currently the majority of teachers use the direct learning model in mathematics classrooms. Mathematics learning in this class is very dominated by teachers and does not involve students actively in learning. The teacher who used of learning media is still very limited and the media used is also conventional media, and it is considered less interactive and less attractive to students because it is still too standard and monotonous.

Mathematical materials which is considered quite difficult for junior high school students is statistics. Statistics is discuses of collection and compiles data, process data, and analyzes data as well as present data based on data collection and analysis carried out. However, this material is quite difficult material for junior high school students because statistics require a high understanding. Besides, the questions presented are usually in the form of story questions or graphical questions that make it difficult for students to understand the meaning and translate the questions into mathematics. So that students have difficulty solving the problems they face.

The ability to solve problems can be improved through student-oriented learning [8], thereby helping students gain ways of thinking in unfamiliar situations they face outside of mathematics class [9]. Problem-solving in learning must also use concrete problems and interactive media support to make students learn problem-solving skills in real life [10]. The ability to solving problem can be improved with student-oriented learning with the Problem Based Learning (PBL) model. Through student-oriented learning with PBL, teachers can more easier help students to maximize their abilities [11].

The development of education in this era cannot be separated from the desire of all education practitioners to improve the quality of teaching in education. Modernization of education is one aspect that determines good teaching methods by teachers, one of which is by integrating technology in learning [12]. Technology can be used in various aspects of education. This can assist teachers and students in transferring knowledge in most countries [13]. Technology is very important in the learning process of mathematics because it can influence what is taught and improve student learning.

Learning design through interactive technology is sought can help students more actively and improve problem-based thinking and learning skills by carrying out learning activities by utilizing developing technology [10]. So that through the use of technology can convey information from teachers to students in a better and more effective manner.

The use of technology in mathematics has been carried out for many years. Teachers use technological assistance that can connect the material with effective and developmentally appropriate assignments where students can be involved in learning mathematics with technology. Today's technology integration has gone through innovation and societal transformation that changes the way people think, work, and live [13]. This new paradigm in the world of learning can be described as a mobile learning model. This learning model appears to respond the technological development recently. The mobile learning is a type of learning that occurs students not in a fixed location, and the students take advantage of the by mobile technology in learning.
One of the popular technologies used to support m-learning is a smartphone. Smartphones [10] are electronic devices that are currently attached to students in Indonesia because they have become part of the student's lifestyle and needs. So, it is important for the use of smartphones to be developed into positive benefits for the development of the world of education by making students actively use smartphones for learning activities.

The design of learning through mobile learning-based e-books is also pursued to involve students actively and improve problem-based thinking and learning skills because smartphone characters can be used independently by students so that students can study anywhere and anytime. Learning with an e-book via a smartphone by doing learning activities used currently developing technology is something positive. In connection with these problems, conducted a research on the development of mobile learning-based e-books used a problem-based learning to improve the ability to solve problems in statistical material for VIII grade at junior high school.

2. Methods

The type is a Development Research (RnD) used the Four-D model (define, design, development, and disseminate). Development research is an activity carried out to create new products or develop existing products and then test the effectiveness of the product being developed [14]. The procedure refers to the Four-D are modified according to the needs and limitations of the study. Activities carried out at the define stage include beginning-end analysis, gathering information, formulating research objectives. The design stage includes instrument preparation, media selection, and initial media design. The development stage includes validation, revision, and limited product testing. The dissemination stage includes field testing, packaging, diffusion, and adoption.

The data collection techniques in this study include observation, teachers interviews, responses questionnaires, and evaluation tests. The instruments used are media validation sheets, teachers and student’s questionnaires sheets, and evaluation tests to measure the student’s problem solving abilities.

Before doing the research, product were developed will be validated by a validator. Expert validation was carried out to determine the feasibility of a mobile learning-based math e-book with a problem-based learning model on statistics material. Product validation is carried out by several experts to assess the products being developed. The subject of product validation consisted of material validators and media validators. The research was conducted of Eighth grade class at SMPN 1 Wonoasri in Madiun, Indonesia.

The data collection technique in this research is the observation method to obtain an overview of the research process, the questionnaire method to determine the respondent's assessment of the mathematics e-book. Before the field trial, the test will be carried out in the trial class to find out whether the instrument is suitable or not for use in field trials. The test questions used in this study were arranged based on the problem solving skills indicators of that have been compiled.

E-book is declared valid if it is developed based on strong theoretical reasons. In other words, the e-book is declared valid if there are no experts who still provide suggestions for improvement on the expert validation sheet and meet the 70% validity criteria. E-books are said to be practical if 70% of the components in the e-book can be implemented by teachers and students with good responses in learning both on teacher learning implementation sheets and student activity sheets. E-books are declared effective if 70% of students can complete learning by meeting the minimum passing standards [15]. The final knowledge value of the statistical material used in the developed e-book is stated to be better than the existing product if in the hypothesis test is concluded that the students can meet completeness study meet minimum 70%.

3. Results and Discussion

This study develop a learning product in the form of a mobile learning-based e-book with a problem-based learning model to increase the ability to solve problem in statistical material for grade VIII SMP. The contents of the e-book that were developed included statistics learning materials, practice
questions, and evaluations that were prepared to increase mathematical problem-solving abilities. The results of developing the e-book used the Four-D model are described as follows.

3.1 Define
In the defined stage, it is carried out to analyze the results of the 2018/2019 Indonesian national exam which shows that mathematics subjects get results that are below the minimum passing standards. The average result of the national mathematics exam in Madiun district shows a result of 48.4 and the average in SMP Wonoasri is 49.7 which is still below the national minimum standard of 55. Furthermore, a needs analysis is carried out which is obtained from the results of observations and the results of filling out a questionnaire, by a class VIII mathematics teacher at SMP Wonoasri. The learning support media used in schools are only conventional media and are still lacking for students to learn mathematics more meaningfully. Besides, teachers have difficulty making supporting media that is attractive and helps students improve their mathematical problem-solving abilities. From the analysis results, found that students needed learning support media that could visualize statistical material so that it was more easily accepted by students and could improve their problem-solving skills. Therefore, a mobile learning-based e-book was prepared to help student improve their ability to solve problems on statistical material.

3.2 Design
By the result analysis of observations in the define stage, then do the initial design of the product that will be developed. At the design stage of the e-book based on mobile learning, mathematics learning is still conceptual and underlies the subsequent development process. At this stage, the design of the e-book design that is used as the product being developed is carried out, as well as the preparation of instruments used to measure the student’s problem solving abilities.

3.3 Develop
At the development stage, a process of validation, revision, and limited product testing is carried out. The mobile learning-based e-book that has been built based on the analysis at the definition stage is then validated to experts to see the deficiencies of the developed product. In this study, there are three validators to validate the products developed. After the developed e-book was examined by the validator, several revisions were made by the comments and suggestions for improvement that had been given by the validator until the e-book was declared valid by achieving an average validity of the three validators of 85.92%. The validity test result of the e-book can showed in Table 1.

| Table 1. Validation results of e-book-based mobile learning |
|-----------------------------------------------------------|
| Assessment aspect | Validity (%) | Category |
|-------------------|--------------|----------|
| Overall validity  | 85.92 %      | Very valid |

Based on validation result, it was found that the overall results of the validation of e-book-based mobile learning were 85.92% in the very valid category. After validity, the developed mobile learning-based e-book was tested on a limited basis with 6 students. From the results of the development test, it was found that the percentage of learning by the teacher was 84.72%, and the percentage of student activity was practically 86.75%. %. The results of the practicality test by the teacher are presented in Table 2, the practicality test result by students can showed in Table 3.

| Table 2. Practical results of e-books based on mobile learning by teachers |
|-------------------------------------------------------------|
| Rated aspect | Practically (%) | Category |
|---------------|-----------------|----------|
| Overall Practical | 84.72%          | Practical |
Table 3. Practical results of e-books based on mobile learning by students

| Rated aspect       | Practically (%) | Category   |
|--------------------|-----------------|------------|
| Overall Practical  | 86.75%          | Very Practical |

The effectiveness of e-book based on the analysis result, the data on a limited trial shows that the mobile learning-based e-book that has been developed is effective to used based on the effectiveness indicators. The classical completeness of students’ problem-solving abilities in limited trials amounted to 74.5%. It means states that the students have met the specified minimum completeness value, which is 70%.

Furthermore, based on the results of limited trials, the developed mobile learning-based e-book will be revised based on follow-up suggestions given by teachers and students so that they can achieve practicality and effectiveness indicators in field trials.

3.4 Dissemination

The steps taken at the dissemination stage are product testing, final product packaging, and product distribution. E-book based on mobile learning is said to be effective if in learning minimum 70% students meet learning completeness. Based on limited trials, the student learning completeness is 74.5%, so it is assumed that learning mathematics used mobile learning-based e-books has met classical completeness. From the limited trial can conclude that the e-books meets the validity, practicality, and effectiveness criteria, it is mean that the e-book developed is feasible and can be used in field trials.

Furthermore, in the field trial it is known that the results of filled out the e-book practicality questionnaire by the teacher are 83.31%, and the percentage of student activeness practically is 88.22%. The results of the practicality test by the teacher can shown in Table 4, the results of the practicality test by students can shown in Table 5.

Table 4. Practical results of mobile learning -based e-books by teachers

| Rated aspect       | Practically (%) | Category |
|--------------------|-----------------|----------|
| Overall e-book practically | 83.31%          | Practical |

Table 5. Practical results of mobile learning-based e-books by teachers

| Rated aspect       | Practically (%) | Category   |
|--------------------|-----------------|------------|
| Overall e-book practically | 88.22%          | Very Practical |

Based on the results of classical completeness of the ability to solve mathematical problems. Students who use mobile learning-based e-books with problem-based learning models in field trials are 86%. It states that students have met the specified minimum learning completeness value, which is 70%. The data analysis results in the field trial showed that the mobile learning-based e-book that was developed was effective based on the predefined indicators. The results of filling out the questionnaire responses by students in the field test obtained 88.22% results, so it was concluded that the student response in the field trial was very good, meaning that the mobile learning-based e-books developed met practical criteria.

After testing the product improvements have been made based on the data obtained from the trial until the product meets the criteria of the valid, practical, and effective, then the developed product is refined in the form of a final product that is ready for use in broader learning, and distribution and delivery of the e-books. It is hoped that the mobile learning-based e-books can used by the teacher for mathematics learning in schools.

A similar result was also conveyed by [13] who in his research at SMP Negeri 2 Sibolangit, Deli Serdang Regency, North Sumatra, to increase students’ problem-solving skills stated that learning based on problem based learning met the effectiveness criteria and could improve mathematical
problem-solving abilities. The use of PBL in SMP to improve problem-solving abilities showed that the average students value by used PBL is better than students who used the conventional learning [16]. The development of learning designs used e-learning effectively in mathematics classes with 89% students can complete individual and classical value after the students used the learning designs were developed [17].

4. Conclusion
Research on mobile learning-based e-book development has been conducted based on problem-based learning to improve the ability to solving problems on statistical materials that have met the valid, practically, and effective, with the details: 1) The validity level of the e-book meets the valid with average result of 85.92%. The e-book were developed in very valid criteria. 2) The practicality level of the e-book meets the practical with an average of 88.22% for students and 83.31% by teachers. 3) The effectiveness of the e-book meets the effective criteria with an average of 84%. From the products tested, it was concluded that the students problem-solving abilities in statistics material used mobile learning-based e-book that had been developed were better than used existing products. Thus, this mobile learning-based e-book used a problem-based learning model to improve problem-solving abilities in eighth grade of statistical material which is suitable for uses and recommended at mathematics learning.

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