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Development of Problem Based Learning-Based Digital Pocket Book to Improve Problem Solving Ability

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ABSTRACT

Abstract: This study aims to determine the problem-based learning-based digital pocket book to improve problem-solving skills that reach the level of validity, practicality and effectiveness. This research method is research and development using 4-D models (Four-D Models) by Thiagarajan. The research subjects were students of class VIII SMP Negeri 12 Pontianak totaling 32 students, experts, and teachers. The instruments used in this study were validation sheets, questionnaires, and posttest questions. Based on the research results, the results of the validation of digital pocket books based on problem based learning to improve problem solving skills have a percentage of 90.44% with very valid criteria. The level of practicality of problem-based learning-based digital pocket books to improve problem-solving skills is classified as having a very practical level with a percentage of 88%. In addition, for the results of the effectiveness level of problem-based learning-based digital pocket books to improve problem-solving skills, the *posttest* average result is 81% with effective criteria. Thus, it can be concluded that the problem-based learning-based digital pocket book to improve problem-solving skills developed can be used because it meets the criteria of very valid validity, very practicality, and effective effectiveness.

Abstrak: Penelitian ini bertujuan untuk mengetahui buku saku digital berbasis *problem based learning* untuk meningkatkan kemampuan pemecahan masalah yang mencapai tingkat kevalidan, kepraktisan dan keefektifan. Metode penelitian ini adalah penelitian pengembangan (*Research and Development)* dengan menggunakan model 4-D (*Four-D Models*) oleh Thiagarajan. Subjek penelitian adalah siswa kelas VIII SMP Negeri 12 Pontianak yang berjumlah 32 orang siswa, ahli, dan guru. Instrumen yang digunakan dalam penelitian ini adalah lembar validasi, angket, dan soal *posttest*. Berdasarkan hasil penelitian diperoleh hasil validasi buku saku digital berbasis *problem based learning* untuk meningkatkan kemampuan pemecahan masalah memiliki persentase 90,44 % dengan kriteria sangat valid. Tingkat kepraktisan terhadap buku saku digital berbasis *problem based learning* untuk meningkatkan kemampuan pemecahan masalah tergolong memiliki tingkat sangat praktis dengan persentasenya sebesar 88%. Selain itu untuk hasil tingkat keefektifan terhadap buku saku digital berbasis *problem based learning* untuk meningkatkan kemampuan pemecahan masalah memiliki hasil rata-rata *posttest* sebesar 81% dengan kriteria efektif. Dengan demikian dapat disimpulkan bahwa buku saku digital berbasis *problem based learning* untuk meningkatkan kemampuan pemecahan masalah yang dikembangkan dapat digunakan karena memenuhi kriteria kevalidan yang sangat valid, kepraktisan yang sangat praktis, dan keefektian yang efektif.

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A. LATAR BELAKANG

Mathematics is an important role, one of which is in aspects of daily life, especially to improve the power of human thought, so that mathematics is a subject that is required at every level from elementary to high school. Learning mathematics by yourself is not only to gain knowledge but also skills. These skills will make students develop and shape the mindset of students in learning mathematics. One of the skills that must be possessed by students is being able to take advantage of advances in education and technology.

The progress of science and technology at this time cannot be separated from the role of education. Therefore, the issue of education is a shared responsibility between families, communities and governments. Educational issues are often an interesting and hot topic of conversation among the wider community, and even more so with education experts. This is one of the references for a teacher in making teaching materials that are in accordance with technological advances.

The Minister of Education and Culture of the Republic of Indonesia Number 54 of 2013 concerning competency standards for elementary and secondary education explains that the objectives of learning in schools include having skills in thinking and acting effectively to solve problems which include the ability to understand problems, design mathematical models, complete models and interpret solutions obtained. . Problem solving ability as a basis that must be possessed by students is the main goal in every learning. Problem solving skills will help students in making decisions and how to think (Setiyani et al, 2021).

Based on the results of interviews with teachers in the field of mathematics in class VIII SMP Negeri 12 Pontianak, it was found that the problem solving abilities of students were still low. The researcher tried to give students problem solving ability questions to check and strengthen the results of interviews with the teachers concerned. It turned out that the results showed that most of the students had difficulty when given story questions that were applied to everyday life. As a result, the development of problem solving skills in students is hampered.

The results of research by Hodiyotno et al (2020) show that choosing the right learning media can help students learn effectively and improve students' mathematical problem solving abilities. Therefore, teaching materials are needed that can help develop students' problem solving abilities. There are a number of reasons why the development of mathematics teaching materials is important because the availability of mathematics teaching materials must match the objectives of learning mathematics in the curriculum, the characteristics of the objectives, and the demands of solving learning problems. There are many teaching materials that can be developed to improve problem solving skills, including digital pocket books.

According to Hermawan & Ekohariyadi (2019), digital pocket books are a combination of pocket books and digital books which have the meaning of small electronic books that contain all the information needed by readers. The development of this digital pocket book focuses on the material of two-variable linear equations by applying a learning design that directs the author to design learning that is used as a guide in the

implementation of learning in order to achieve effective, efficient, and interesting learning. In addition to the use of teaching materials in learning, of course, to help achieve learning objectives, you must use a learning model that is in accordance with the problems at hand. So to solve the problem of low problem solving skills in students, problem-oriented learning models are used, one of which is Problem Based Learning (PBL).

According to Hodiyanto (2019), the PBL learning model generally aims to get to know students about a problem or case that is in accordance with the material being studied and is required to carry out activities to solve a problem. The PBL model is also a place for students to be able to develop critical thinking and higher-order thinking skills. Through this PBL-based learning tool, students can hone their mathematical problem solving skills, because PBL is a learning model that involves students directly carrying out the stages of activities to solve a problem in their own way by using various information or references without having to based on and imitating the work done by teachers in solving problems that are applied in everyday life (Yustianingsih et al, 2017).

The results of Gunantara's (2014) research show that the problem-based learning model can improve students' problem-solving abilities. Therefore, in this study, researchers tried to use a problem based learning model to solve problems at SMP Negeri 12 Pontianak. The purpose of this study was to determine the level of validity, practicality, and effectiveness of a Problem Based Learning (PBL) digital pocket book with character content to improve the problem-solving abilities of Class VIII SMP Negeri 12 Pontianak.

B. RESEARCH METHOD

This study is a Research and Development (R & D) research using a 4-D model (four-D models) which consists of four stages, namely: the definition stage, the planning stage (design), the development stage (develop), and the defining stage (disseminate). However, this research only reached the development stage. At the definition stage, it is determined and defined based on the needs and problems found in the field. In addition, at this stage it is carried out to identify and determine the basic problems needed in development. Furthermore, identification is carried out to study the needs of students in accordance with the competencies to be studied such as identification of core competencies, basic competencies, indicators, and main materials that are in accordance with learning objectives.

The second stage is design. This stage is the initial stage of planning a digital pocket book that will be used in the research process. In addition, the preparation of instruments such as validation sheet grids and questionnaire grids was also carried out to assess the validity, practicality, and effectiveness of digital pocket books. The third stage is development. At this stage the digital pocket book that has been designed is validated by experts so that information is obtained in the form of input, evaluation, and revision of the digital pocket book model that has been designed. A digital pocket book that has been revised based on the proposals of the validators, is then tested on students. The digital pocket book development flow is as shown in Figure 1.

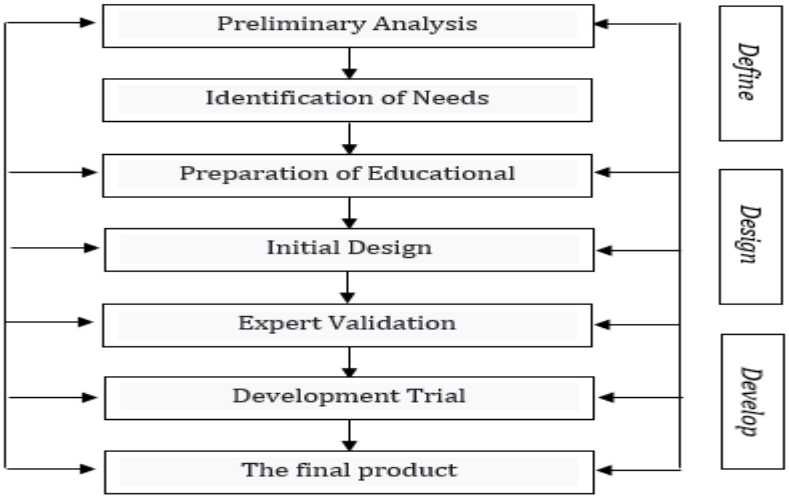

Figure 1 **.** Research Procedure

The research subjects were students of class VIII SMP Negeri 12 Pontianak which consisted of 30 students. This class was used during a field trial of using a digital pocket book. The trial aims to determine the problem-solving ability of students after learning by using a developed digital pocket book. In addition, he also aims to obtain input for the improvement of digital pocket books.

The data analysis technique that will be carried out is to describe in a narrative manner the steps of developing a digital pocket book starting from the definition stage to the development stage. At the development stage, the validation results were described from three validators who assessed the quality of the digital pocket book that had been produced from the design stage. The criteria for validity, practicality, and effectiveness adapted from Nieveen (Kurniawan et al, 2016) can be seen in the table below.

Table 1. Digital Pocket Book Validation Criteria

Average	Validation Criteria
0% - 20%	Very Invalid
21% - 40%	Less Valid
41% - 60%	Quite Valid
61% - 80%	Valid
81% - 100%	Very Valid

(Oktaviana & Susiaty, 2020)

Table 2. Criteria for Practicality of Digital Pocket Books

Average	Practical Criteria
0% - 20%	Very Less Practical
21% - 40%	Less Practical
41% - 60%	Practical enough
61% - 80%	Practical
81% - 100%	Very Practical

(Oktaviana & Susiaty, 2020)

Posttest data results by finding the average value of effectiveness using the following formula:

$$M = \frac{\sum X}{n}$$

The effectiveness of the digital pocket book is obtained based on the KKM mathematics set by SMP Negeri 12 Pontianak, which is 75. Students are said to be complete if they get an average score of 75.

C. RESULTS AND DISCUSSION

1. Research Results

After the initial design and design have been obtained, then proceed to the development stage. This development stage is expert validation and development trials.

a. Expert Validation

In this study, media validation was reviewed by 2 validators, namely one lecturer in the information technology and technology education study program and one teacher in the mathematics education study program. Suggestions from the validator are used as input for revising the problem-based learning-based digital pocket book containing characters to improve problem-solving skills so that the digital pocket book is valid and ready to be tested on class VIII students of SMP Negeri 12 Pontianak as research subjects. Below will be presented the results of expert validation.

1) Validation by material expert

Material experts provide an assessment of aspects of learning, content, and evaluation. The assessment of the material expert can be calculated by the following formula:

$$P = \frac{the\ number\ of\ score\ answers\ by\ expert\ assessment}{highest\ score\ count} \times 100\%$$

The results of material expert research on digital pocket book media can be seen in Table 3 below:

Table 3. Results of Validation of Digital Pocket Books by Material Experts

No	Material Expert	Evaluation(%)	Criteria
1	Wandra Irvandi, S.Pd. M.Sc	91,11%	Very Valid
2	Eka Wijayanti S.Pd	94,44%	Very Valid
	Average	92,77%	Very Valid

Based on Table 3. the validation results from two material experts obtained an average percentage of 92.77% with very valid criteria so that the digital pocket book media is suitable for use as learning media without revision.

2) Validation by media experts

Media experts provide an assessment of three indicators, namely: display, programming, and multimedia principles. The assessment of media experts can be calculated by the following formula:

$$P = \frac{the\ number\ of\ score\ answers\ by\ expert\ assessment}{highest\ score\ count} \times 100\%$$

The results of media expert research on digital pocket book media can be seen in Table 4. below:

Table 4. Results of Validation of Digital Pocket Books by Media Experts

No	Media Expert	Evaluation (%)	Criteria
1	Nurbani, S.T, M.Pd	87,14%	Very Valid
2	Eka Wijayanti, S.Pd	92,85%	Very Valid
	Average	89.99%	Very Valid

Based on Table 4 the validation results from two media experts obtained an average percentage of 89.99% with very valid criteria so that it is suitable for use as learning media with revisions.

3) Expert validation results

Based on calculations from the results of the validation of material experts and media experts, the level of validity of the digital pocket book media used to answer the first problem formulation is shown in Table 4.17 as follows:

Table 5. Average Expert Validation Results

No	Expert	Evaluation(%)	Criteria
1	Material Expert	92,77%	Very Valid
2	Media Expert	89,99%	Very Valid
	Average	91,38%	Very Valid

Table 5. shows that the level of validation of the problem-based learning (PBL) digital pocket book media with character content to improve the problem solving ability of class VIII students of SMP Negeri 12 Pontianak has very valid criteria with an average of 91.38%.

b. Product Trial and Revision

After the digital pocket book media is validated and revised, the next step is to test the product in certain schools. The product trial was carried out in class VIII of SMP Negeri 12 Pontianak which will be applied to all students in the class, totaling 32 students divided into 2, namely session 1 and session 2. The product trial activity was carried out in 2 meetings for each -each session, namely meeting 1 on Wednesday, November 3, 2021, learning is carried out using a problem-based learning (PBL) digital pocket book containing characters to improve problem-solving skills. Then Meeting 2 on Thursday 4 November 2021 includes giving Posttest questions and filling out response questionnaires (teachers and students), as well as in session 2 the following week. The results of product trials conducted in this study are as follows:

1) Practicality

The practicality of the digital pocket book is seen from the teacher and student response questionnaires. The results of the questionnaire were used to revise the digital pocket book into a final product. The following are the results of teacher and student questionnaire responses to digital pocket books:

Table 6. Results of Teacher and Student Response Questionnaires

No	Response	Evaluation(%)	Criteria
1	Teacher	90,9%	Very Practical
2	Student	85,10%	Very Practical
	Average	88%	Very Practical

Based on the results of the questionnaire responses of teachers and students to digital pocket books, it is found that the practicality level of digital pocketbooks is used to answer the second problem formulation. Table 4.18 shows that the practicality of digital pocket books based on problem-based learning is filled with characters to improve problem solving abilities of class VIII SMP Negeri students. 12 Pontianak has very practical criteria with an average percentage of 88%.

2) Effectiveness

The effectiveness of the digital pocket book is seen from the results of the posttest that has been done by class VIII students of SMP Negeri 12 Pontianak in accordance with the aspect of problem solving abilities. The posttest results obtained 24 students who completed and 8 students did not complete because the scores obtained were below the KKM. The following are the results of the average posttest of students.

Table 7. Students' Average Posttest Results

Index Percentage	Criteria
81,4%	Effective/Completed

Based on table 4.19, the results of the posttest of class VIII SMP Negeri 12 Pontianak included the effective/complete criteria with a percentage of 81.4%.

3) The final product

After testing the product, the results of the improvement based on input from validators, teachers, and students on the digital pocket book, then the digital pocket book is ready to be packaged as a final product.

2. Discussion

The process of developing a problem-based learning (PBL) digital pocket book containing characters to improve the problem solving abilities of class VIII students of SMP Negeri 12 Pontianak using a 4-D research design, which consists of define, design, development, and dissemination. The define stage aims to identify the needs that exist in the field. The design stage is a stage carried out by researchers to compile instruments that will be used in research, as well as to make an initial design of the product being developed. While the develop stage is the stage of product development that has been revised based on input from expert validators and the results of product trials to produce the final product of a digital pocket book. However, in this study, the steps taken did not reach the Dissemination stage, because the research subjects only included one school and there were limitations of time and cost so that it was not possible to do dissemination.

The elaboration of the stages of this research are: 1) define which consists of an initial analysis that aims to identify and determine the basic problems faced in the learning process for both teachers and students obtained from interviews and questionnaires on the needs of teachers and students. Then proceed with the identification of needs to find solutions to the problems that have been analyzed previously. 2) design (design) this stage is carried out to design the development product at the definition stage. This product design is called the initial design which

consists of the preparation of a digital pocket book, a teacher response questionnaire, a student response questionnaire, a material expert validation sheet, a media expert validation sheet, a teacher response questionnaire validation sheet and a student response questionnaire validation sheet, the initial design of a digital pocket book. 3) development (development) this stage aims to develop a product that has been revised based on input from experts and product trials.

The 4-D design carried out aims to see the validity, practicality, and effectiveness of digital pocket books. According to Nieveen (Kurniawan et al, 2016) that a learning device is good if it meets the criteria of validity, practicality, and effectiveness. By knowing the criteria for the resulting product, the resulting product can be used by a wider environment according to the purpose of its manufacture. The results of the validation of the digital pocket book with an average value of 91.38% with very valid criteria. At the time of validation, there were suggestions and comments from the validator so that there were some parts of the digital pocket book that needed to be improved and added.

After the digital pocket book has finished validating, the next stage is product testing. This product trial aims to determine the practicality of the developed digital pocket book and to determine the effectiveness after using a digital pocket book. To find out the practicality, the average response from students for the practicality of digital pocket books is 85.10% with very practical criteria involving 32 class VIII students of SMP Negeri 12 Pontianak. Meanwhile, the teacher's response questionnaire obtained a percentage of 90.9% with very practical criteria.

Furthermore, to determine the effectiveness of the digital pocket book, it is done by giving a posttest which contains 3 description questions. The posttest was given to the same subject, namely class VIII SMP Negeri 12 Pontianak, totaling 32 people. The results showed that the posttest results stated that 24 students completed and 8 students did not complete because the value obtained was below the KKM, which was 75, so that the digital pocket book could be said to be effective because classical completeness obtained a percentage of 81.4%. The results of this study are also in line with research conducted by Sulistri et al (2020) the results of the pocket book which obtained research results for a level of 81.41% in very valid criteria, from practicality results with an average of 95% with very practical criteria.

In this study, a digital pocket book based on problem based learning (PBL) which was developed containing characters to improve problem skills in two-variable linear equations, which aims to create materials and questions related to everyday life, as well as instill character values in problems. and each stage of the problem based learning (PBL) model. This is in accordance with the opinion of Yustianingsih et al. (2017) which states that PBL is one of the learning models that mathematics teachers can use to help students find a mathematical concept and at the same time improve mathematical problem solving skills and student activities. According to Putri (2013), it is stated that the purpose of building the character and character of the nation through education is absolutely necessary, it cannot even be postponed. Education that develops character is a form of education that can help develop ethical, moral, and

responsible attitudes, give love to students by showing and teaching good character. Characters that must be instilled in students include; love for Allah and the universe and its contents, responsibility, discipline and independence, honesty, respect and courtesy, compassion, caring and cooperation, confidence and creativity, hard work and unyielding, justice, and leadership, kind and humble , tolerance, love of peace and unity. These character values are contained in the stages of Problem Based Learning (PBL) in digital pocket books and also in the problems given to students.

The digital pocket book was created using the PowerPoint application and the Flip PDF Corporate Edition. The PowerPoint application is used to create digital pocketbook designs, which are then converted to pdf so that the pocketbooks that have been created can be used in the Flip PDF Corporate Edition application. Digital pocket books are also made attractive with a composition of colors, images, and various types of writing. The parts of the digital pocket book developed are outer cover, inner cover, foreword, table of contents, introduction, basic competencies & competency achievement indicators, concept maps, material based on the steps of the PBL model containing characters and using questions related to indicators of problem-solving abilities, as well as learning evaluation questions, bibliography. Therefore, a problem-based learning (PBL) digital pocket book containing characters will help students develop problem-solving skills because in addition to being required to solve the problems given, they are also required to solve problems in groups. The results of this study are supported by the results of research by Gunantara et al (2014) that the problem based learning (PBL) learning model can improve students' problem solving abilities.

The steps of the problem based learning (PBL) learning model contained in the digital pocket book are as follows: 1) Student orientation to the problem. At this stage the teacher conveys the learning objectives, and motivates students to be involved in overcoming problems. 2) Organizing students to learn. at this stage, students define and organize learning tasks related to the problem. 3) Guiding individual and group investigations. At this stage, students are encouraged to collect information and carry out experiments to obtain explanations and problem solving. 4) Develop and present the work. At this stage, students design and prepare works that are in accordance with the problem-solving plans that have been made with their friends. 5) analyze and evaluate the problem solving process. At this stage, students evaluate the problem-solving process they use.

After the results of the development of the digital pocket book have been declared suitable for use, it is expected to be able to have a good impact in the mathematics learning process and for the future it can be used when needed which becomes relevant and quality learning resources and can help develop students' problem solving abilities.

In addition to some of the things that have been described in this study, there are also some limitations in this research process. The limitations in this study are:

a. This research was not continued to the Disseminate stage because the research subjects only included one school and limited time and cost.
b. Difficulty in finding reference books and journals related to digital pocket books.

c. Researchers have difficulties in designing digital pocket books made in PowerPoint and in Flip PDF Corporate Edition.

D. CONCLUSIONS AND SUGGESTIONS

Based on the results of research and development of problem-based learning-based digital pocket books to improve problem-solving abilities that have been carried out, it is concluded that this development uses several stages of 4-D models (Four-D Models). Problem-based learning-based digital pocket books to improve problem-solving skills have a percentage of 90.44% with very valid criteria. The level of practicality of problem-based learning-based digital pocket books to improve problem-solving skills has a percentage of 88% with very practical criteria. In addition, the results of the effectiveness of digital pocket books based on problem based learning to improve problem solving skills have a percentage of 81% with effective criteria.

The digital pocket book developed in this study can still be continued by other researchers to the stage of dissemination or dissemination in other classes, by other teachers, other schools and on a wider scale. This digital pocket book also needs to be further refined with further trials in the dissemination stage, so that the quality of the digital pocket book is truly tested in terms of its utilization and can be used optimally.

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