Android-Based Learning Media Design with Contextual Learning to Develop Problem-Solving Skills

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Abstract. *This study objective is to show that android-based learning media design with contextual learning is valid, practical, and effective in developing mathematical problem solving skills. The research method used is Research and Devolopment. It's design in this study is 4-D development model consisting of 4 development stages: define, design, develop, and desseminate. The subjects of this study consisted of development subjects (validators) and field trial subjects (a private senior high school in Pontianak, Indonesia). Data collection tools used were validation sheets, questionnaires and mathematical problem solving skill tests. The data analysis technique used descriptive statistics. This study showed that android-based media with contextual learning content was valid, practical and effective in developing mathematical problem-solving skills. In addition, Android-based learning media with contextual learning content could be used as an alternative in learning during Covid 19.*

Keywords: *problem solving skills, android-based learning media, adobe flash cs6, contextual learning*

Introduction

The student's learning success can be seen from how he is able to solve the problems facing both in the learning process and activities outside the learning process. This relates to the student's skill to solve problems or problem solving skill. Problem solving skill is an attempt to find a solution to a problem that is not easy to solve immediately (Bell & Polya, 1945). Problem solving skills are one of the abilities that students must have in learning mathematics (Hanifah & Nuraeni, 2020; Latifah & Luritawaty, 2020; Rinaldi & Afriansyah, 2019). Mathematical problem-solving skill is one of the high order thinking skills (HOTS) that need to be developed (Hodiyanto & Firdaus, 2020; Miri, David, & Uri, 2007) and hard skills (Hendriana, Rohaeti, & Sumarmo, 2017; Hodiyanto, Darma, & Putra, 2020). Previous studies show that students are low in solving problems related to mathematical problem solving skills (Bruun & Pearce, 2013; Hodiyanto et al., 2020; Risnawati, Amir, & Wahyuningsih, 2018; Salemeh & Etchells, 2016; Seifi, Haghverdi, & Azizmohamadi, 2012).

The results of preliminary study in one of private senior high schools Pontianak showed that students had difficulty in solving math problems, especially those related to three-variable linear equation systems. Students could not determine what was known and asked in questions. Students also found it difficult to imagine and apply the solution. Besides that, they

also did not double-check their answers. These results were also strengthened by the results of giving problem-solving skill tests to students. In addition, researchers also observed on the learning media used in the school. Most of the subject matters were given only from textbooks, worksheets, and occasionally using powerpoint. It was what causes the development of mathematical problem solving skills in students to be hampered.

In addition, the current condition is exacerbated by the Covid 19 hitting the world, including Indonesia, so that it impacts on education in Indonesia. The government instructs the public to work from home and study from home. Online learning is the only way that can be done so that students continue to carry out learning. However, the results of the research show that students prefer face-to-face learning rather than online learning (Dewi, 2020; Jamaluddin, Ratnasih, Gunawan, & Paujiah, 2020; Wahid, Pribadi, & Wakas, 2020). This means that online learning that has been carried out by teachers and lecturers is not in accordance with what is expected by students. There are so many factors that cause online learning to be unoptimal so far in schools and campus. One of the most influential factors is the media that has been used by teachers and lecturers only using applications that are spread on the internet such as Whatsap and you tobe (Dewantara, Amir, & Harnida, 2020). Therefore, it is necessary to develop learning media that can help and support online learning so learning is more enjoyable and more varied.

The study result Hodiyanto et al. (2020) showed that learning using macromedia flash with problem posing was classified as effective in developing mathematical problem solving skill But this macromedia flash developed still uses a laptop and its application will be better face-to-face between teachers and students as well as lecturers and students. Therefore, it is necessary to carry out further research by designing macromedia flash learning media that can be accessed via Android which can be accessed wherever students are. One application that is similar to macromedia flash but has undergone an update or the latest version of macromedia flash is adobe flash Professional CS6. Adobe Flash CS6 is the latest version of Macromedia Flash which can be installed on Android so that researchers try to design android-based adobe flash Professional CS6 learning media to improve mathematical problem solving skill. This research is a continuation of research that has been done by previous researchers by developing macromedia flash loaded with problem posing (Hodiyanto et al., 2020). The difference between this study and previous research is that Macromedia Flash previously could not be installed on Android and was loaded with problem posing, but in this study the media to be developed would be installed on Android and contain contextual learning.

Adobe Flash Professional CS6 is a software specially designed by Adobe. One of the other interesting features of Adobe Flash Professional CS6 is AIR for Android. AIR for Android

uses the programming language of Action Script 3 (AS3). This feature can be used to create learning media that can later be installed on an Android-based smartphone device. In addition, there are several studies that develop Android-based learning media to increase problem-solving skill (Hendikawati, Zahid, & Arifudin, 2019) but the media is not Adobe flash. This learning media developed is modified with contextual learning.

Contextual learning is learning that is related to the daily lives of students so that learning will be more meaningful to students because the material presented is directly related to students' daily lives (Komalasari, 2013). The results showed that contextual learning can improve students' problem solving skills (Surya & Putri, 2017) and student learning outcomes given contextual learning are better than student learning outcomes taught with realistic learning (Susiaty & Hodiyanto, 2019). The purpose of this study is to show that Android-based learning media is valid, practical, and effective in improving mathematical problem solving skills.

Method

The research method used in this research is R&D (Research and Development). The research and development design in this study is a 4-D development model. The 4-D model consists of 4 stages of development: define, design, develop, and desseminate by Thiagarajan (Sugiyono, 2015). However, due to limited time and cost this research is only up to develop. The subject of this study only one school and one class and this research is only shown to solve the problems that exist in a private senior high school Muhammadiyah 2 Pontianak. So the stage used is only up to the third stage, development stage, not at the dissemination stage.

The subjects of this study are the validators (experts) consisting of three people and students of class X as subject of field trials, at a private senior high school Muhammadiyah 2 Pontianak. Data collection techniques in this study are indirect communication techniques and measurement techniques so that the data collection tools used are: (1) Validation sheets, validation sheets for learning media and validation sheets for students' problem solving skill test and response questionnaires. The validation sheet is made to meet the objectives of validity (2) The response questionnaire is made to meet the practical objectives (3) The problem-solving skill test in the form of description questions essay questions. Tests were created to meet the research objectives of effectiveness. The data analysis technique used descriptive statistics. In this study, the media is declared to have good validity and practicality if the percentage of validation index and response reaches the minimum criteria above 65% (Hodiyanto et al., 2020), while the level of effectiveness is seen from the test results of problem-solving skill which will be seen from the minimum completeness criteria (MCC). This is in accordance with the opinion Damopolii, Bito, and Resmawan (2020) in their research that learning media is said to be

effective if student learning outcomes reach classical minimum completeness criteria (CMCC). Android-based learning media is effective if 65% of students achieve CMCC.

Results and Discussion

This research activity has succeeded in developing adobe flash cs6 media based on android with contextual learning content to problem-solving skills in the material of three-variable linear equation system in a private senior high school Muhammadiyah 2 Pontianak. The development process of Android-based Adobe Flash CS6 media contains a contextual learning in this study using a 4-D design, as follows:

Difine

This activity is carried out to define development requirements. The define stage is divided into two, the initial analysis and identification of needs.

Initial analysis

The first step that the researchers took in this study was interviews with a mathematics teacher and pre-observation with three students. From the results of the interview, the information obtained was that students had difficulty solving math problems, especially those related to the three-variable linear equation system. Students are low in determining what is known and asked in questions. Students also find it difficult to imagine and apply the solution. Besides that, most students also did not double-check their answers in doing the questions. Furthermore, from the results of pre-observations made by researchers to three students, it can be concluded that students are still not skilled in solving mathematical problems.

Moreover, recently the world was shocked by a virus covid-19. Covid-19 is a virus that was first discovered in the city of Wuhan, China at the end of 2019. A number of schools and colleges have stopped teaching and learning in classrooms to prevent the spread of covid-19. The Minister of Education and Culture, Nadiem Makarim, requires that educational institutions treat online learning. Therefore, we need a learning media or develop a new learning media that can help develop students' mathematical problem solving skills and can be used in learning. One of the media that can be used t besides books, whiteboards, and teaching aids as learning media is a smartphone (Android). The learning media in question is Adobe Flash CS6 learning media that uses an Android smartphone device.

To realize a more active and meaningful learning, an learning is needed that can condition students to participate actively. One of them is the contextual learning. The purpose of this contextual learning is to motivate students to understand the meaning of the subject matter they

are learning by linking the material to the context of their daily life (personal, social, and cultural context) so that students will more easily understand the material and learning will be more meaningful. Some of the characteristics of contextual learning are constructivism, questioning, inquiry, learning community, modeling, reflection, and authentic assessment.

Need Analyses

The next stage, the researcher defines the students' needs in studying the material of the three-variable linear equation system. Where the material is adjusted to core competencies, basic competencies, and learning indicators so that learning objectives can be achieved.

Design

This stage is carried out to design development products that are tailored to the problems obtained in the field during the definition stage.

Initial Design

This initial design will be validated with the aim of revising and improving the Android-based Adobe Flash CS6 before being tested. The initial design of the Android-based adobe flash CS6 was adjusted to a contextual learning or called Smart Math which has the following design: (1) Splash Screen: the Splash Screen is the first display of the application when opened. The Splash Screen will appear just before the main application is run. This application displays 2 Splash Screens. The first Splash Screen displays the logo of the application maker, and the second shows the Splash Screen with a loading bar. (2) Main Menu: the main menu will appear after the splashscreen. This menu has 2 main menu buttons, the start menu button and profile. In addition, this menu also has one additional alternative button, the application exit button, where each option button has its own use as shown in Figure 1. (3) Profile Menu Display: This profile menu will display information about the application and short profile of developer. (4) Start Menu: On the start menu there are 4 sub menus and a back button that will be displayed, namely the competence menu, materials, discussions, and exercises. (5) Competence Menu: The competency menu will display basic competencies, indicators of competence achievement and buttons (next ($>$), back ($<$), and exit (X)). (6) Menu Material: The material menu will display a concept map, learning objectives, problems, and three-variable linear equation system materials. (7) Discussion menu: The discussion menu will display 2 sub menus, the discussion menu and the summary menu. The discussion menu will display discussion questions and the summary menu will display a summary of the material. (8) Exercise menu: On the training menu displays practice questions.
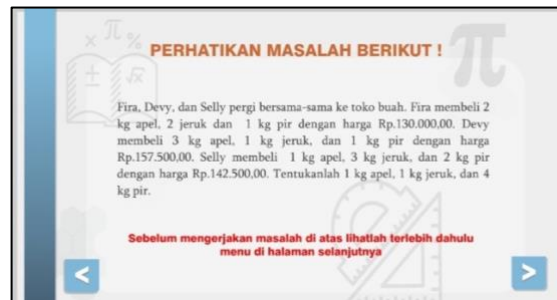
Figure 1. Application main menu display

Figure 2. Problem display to be solved

Develop

As a follow-up to the design that has been carried out in the design stage, a development stage is carried out to produce what has been revised based on comments and suggestions from the validator. Activities at this development stage are validation and development trials as follows.

In this study, the validation process was carried out by three validators who understood the arrangement of Android-based Adobe Flash CS6 and were competent, two lecturers of mathematics education at the IKIP PGRI Pontianak and a lecturer in informatics engineering STIMIK Pontianak. Suggestions from the validator will be used as input for revising Android-based Adobe Flash CS6 so that it is valid and ready to be tested on class X students of a private senior high school Muhammadiyah 2 Pontianak as research subjects.:

The material expert provides an assessment of the aspects of content feasibility, presentation feasibility, language assessment, contextual learning assessment. The average assessment of material experts on Android-based Adobe Flash CS6 media can be seen in the following Table 1.

Table 1. Material validation results by experts

No	Experts	Assessment (%)	Criteria
1	Validator 1	88,67%	Valid
2	Validator 2	77,33%	Valid
3	Validator 3	95,33%	Valid
	Average	87,11%	Valid

Based on Table 1, the results of the validation of three material experts obtained an average percentage of 87.11% with valid criteria so that Android-based Adobe Flash CS6 is suitable for use as a learning medium. There are several comments and suggestions given by experts for revision. After the revision is made, then the Android-based Adobe Flash CS6 can be used in research.

Experts provide an assessment of three indicators: size, design, and content design. The average assessment of media experts on Android-based Adobe Flash CS6 media can be seen in the following Table 2.

Table 2. Media validation results by experts

No	Experts	Assessment (%)	Criteria
1	Validator 1	87,69%	Valid
2	Validator 2	83,08%	Valid
3	Validator 3	94,62%	Valid
	Average	88,46%	Valid

The results of the validation of three media experts obtained an average percentage of 88.46% with valid criteria so that android-based Adobe Flash CS6 is suitable for use as a learning medium. There are several comments and suggestions given by experts for revision. After the revision is made, then the Android-based Adobe Flash CS6 can be used in research. Based on calculations from the validation results of material and media experts, the validity level of Android-based Adobe Flash CS6 which is used to answer the first research purpose is shown in the Table 3.

Table 3. Validation results

No	Expert	Assessment (%)	Criteria
1	Material	87,11 %	Valid
2	Media	88,46 %	Valid
	Average	87,78 %	Valid

The results in the Table 3, shows that the validity level of Adobe Flash Professional CS6 learning media based on Android contains a contextual learning to problem solving skill in the material of three-variable linear equation system in a private senior high school Muhammadiyah 2 Pontianak has valid criteria with an average percentage of 87.78 %.

Product Test

After the Android-based Adobe Flash Professional CS6 is validated and revised, the next step is to conduct product trials at certain schools. The school referred to in this study is a private senior high school Muhammadiyah 2 Pontianak to determine practicality and effectiveness for students. (1) Practicality: In this study, the practicality assessment was filled by 30 class X students. They they fill out a response questionnaire to the Android-based CS6 Adobe Flash Professional application that had been used during the learning process. In addition, suggestions and comments on responses to Android-based Adobe Flash Professional CS6 will be considered in the Android-based Adobe Flash Professional CS6 revision. Based on the results of the calculation of the percentage of student practicality index, the percentage value of practicality of 85.8% was obtained, including in the practical category. (2) Effectiveness: In this study, the effectiveness was seen from the results of the post test. After learning using Adobe Flash Professional CS6 based on Android, students are given a post test using questions that are suitable for use. There are 4 questions for the post test. The post test give 30 students

then given scores based on scoring guidelines for mathematical problem solving skills. The results of the post-test problem-solving skills can be seen in Figure 3.
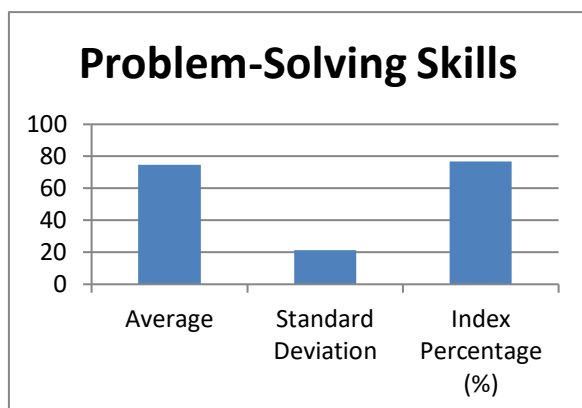

Figure 3. Post test of problem-solving skills

Based on the results of the post test, 23 students who completed and 7 students did not complete because the scores they obtained were below the minimum completeness criteria (MCC). In figure 3, it is found that average score of 30 students of class X obtained a value of 74.69. Thus, the level of effectiveness of the Android-based Adobe Flash Professional CS6 media contains contextual contextual learning to problem-solving skill in the material of three-variable linear equation system can be said to be effective because classical completeness gets a percentage of 76.67%.

The final product

After conducting a limited trial, the researchers made the final revision based on the test data, so that the final product was produced. However, based on suggestions and comments from experts, researchers hope that this application can be used by teachers as an alternative learning medium and make online learning easier.

The development of adobe flash professional CS6 media based on android contains a contextual learning to problem solving skills in the material of the three-variable linear equation system for class X students of a private senior high school Muhammadiyah 2 Pontianak uses the 4-D development model recommended by Thiagarajan (Sugiyono, 2015) which consists of define, design, develop, and desseminate. The Define stage aims to define the needs that exist in the field so that researchers know what problems are being faced and and their solutions. The Design stage aims to make the initial design of the product to be developed according to the needs in the school. The develop stage aims to develop a revised product based on input from experts and limited trials. However, in this study it only reached the develop stage because the research subjects included only one school and one class, so it was not possible to distribute

them. The 4-D design carried out aims to see the validity, practicality, and effectiveness of the Android-based Adobe Flash Professional CS6. This is in accordance with the opinion of Nieeven (Haviz, 2016) who said that the quality of learning media development results in development research is determined by several criteria, namely validity, practicality, and effectiveness.

Analysis of the Android-based Adobe Flash Professional CS6 validation by material experts obtained an average percentage of 87.11%, while in the Android-based Adobe Flash Professional CS6 validation analysis by media experts, an average percentage of 88.46% was obtained with valid criteria, so that the android based learning media is feasible to use. The results of calculations by material experts and media experts obtained an average percentage of 87.78% with valid criteria, so that the Android-based Adobe Flash Professional CS6 developed can be used appropriately as a learning medium.

After carrying out the validation stage, the next stage is product testing. This product trial aims to determine the practicality and effectiveness of the developed Adobe Flash Professional CS6 learning media. To find out the practicality of this study, this research was carried out by giving a student response questionnaire to 30 students of class X of private senior high school Muhammadiyah 2 Pontianak with an average value of student responses to Android-based Adobe Flash Professional CS6 of 85.8% with practical criteria.

To find out the effectiveness of the Android-based Adobe Flash Professional CS6 media, it is done by giving a post test consisting of 4 description questions. The post test was given to the research subjects, 30 students. The results showed that the results of the post test stated that 23 students completed and 7 students did not complete because the scores they received were below the MCC score. However, overall the classical completeness value obtained the percentage of effectiveness of 76.67% with the effective criteria. This is also in line with research conducted by Hodiyanto et al. (2020) that the macromedia flash learning media containing problem posing are classified as effective in increasing students' problem solving skills. The results of this study are also in accordance with the researches of Khuzaini and Sulistyo (2018) and Widyanto (2016) in the study concluding that learning media based on adobe flash professional CS 6 are effective in improving student learning outcomes and problem solving skills are part of learning outcomes.

Media adobe flash professional cs6 based on android collaborating with a contextual learning, which aims at materials and questions related to everyday life. Making Adobe Flash Professional CS6 based on Android uses the Adobe Flash Action Script 3 application by designing various displays of menus or scenes in the application consisting of: splash screen, loading screen, main menu, profile menu, start menu and exit menu. The start menu displays 4

sub menus, the competency menu, material menu, discussion menu, and training menu. Each menu has several views such as the competency menu which contains basic competency displays and indicator displays, the material menu contains concept map views, learning objectives, contextual issues, and three-variable linear equation system materials, the discussion menu contains discussion and summary views, and the training menu contains displays of practice questions. Adobe Flash Professional CS6 based on Android is also made attractive with a variety of color compositions. Therefore, this Android-based Adobe Flash Professional CS6 can improve students' skills in solving mathematical problems.

In this research, Adobe Flash CS6 based on Android which was developed contains a contextual learning to the material of three-variable linear equation systems (TVLEQ) in order to be can improve students' mathematical problem solving skills. Contextual learning is learning that produces meaning by connecting TVLEQ material with the context of students' daily lives (Johnson, 2002). The results of this researh are supported by the findings of Surya and Putri, (2017), Widiati (2014), Yuniarti, Kusumah, Suryadi, and Bana (2017), and Amir (2015) that contextual learning can improve students' problem solving skills. This happens because of the characteristics that exist in contextual learning: constructivism, inquiry, questioning, learning community, modeling, reflection, and authentic assessment. In the adobe flash application, students are asked to recall the material of the two-variable linear equation system so that students will build their own understanding from understanding the two-variable linear equation system to understand the three-variable linear equation system (constructivism). In addition, Adobe Flash presents problems related to students' daily lives in the material of the three-variable linear equation system so students understand the material more easily and learning will be more meaningful. From these problems, students will discuss and ask each other both between friends and with the teacher to find solutions and understand the three-variable linear equation system (inquiry, questioning, learning community). At the end of the lesson, students are invited to reflect, what is not understood and make conclusions from what they have learned (reflection) and end with giving questions to determine the extent of students' understanding of the the three-variable linear equation system (authentic assessment).

Conclusion

Based on the results of research and discussion, the results of this study can be concluded that android-based media with contextual learning content is classified as valid, practical and effective in improving mathematical problem solving skills. The results of this research can be continued by developing Android-based learning media with contextual learning content to other hard skills such as mathematical communication skills and mathematical connection skills.

In addition, the next researcher can develop other android-based learning media except Adobe Flash CS6. In addition, Android-based learning media with contextual learning can be used as an alternative in learning during Covid 19.

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