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Development of Android-Based Mobile Learning Media Using ADDIE Model on Static Fluid Topics for High School 11th Grade Students

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Abstract

The aim of this research and development study was to create a mobile learning application based on the Android platform to facilitate the teaching and learning of static fluid concepts. The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model was employed as the framework for the research methodology. The data collection instruments included validation questionnaires completed by subject matter experts, media experts, physics teachers, and students. These were administered during small group and large group trials conducted with 11th grade science students at MAN 1 Lotim. The end product was an Android-based learning app that received an overall good rating with a total score of 82. Evaluation by media experts deemed it good, with a score of 60 out of a maximum of 75. Physics teachers who validated the app rated it as very good/effective with a score of 52. During the large group trial with students, the app gained a high score of 1759, averaging 4.31 which falls into the very interesting category. Based on the validation results and feedback obtained, it can be concluded that the Android-based mobile learning application developed in this study is suitable, effective, and practical to be utilized as an instructional tool for teaching static fluid concepts to high school 11th grade students in physics education programs.

INTRODUCTION

The progress of a country is greatly determined by the quality of its human resources (HR). The quality of human resources depends significantly on the quality of education. Education plays a crucial role in national development. The success of educational development will greatly influence the progress of other fields. Therefore, the more advancements in education, the better. One way to increase knowledge is through education. Education is a conscious and planned effort to create an atmosphere and learning process that allows learners to actively develop their potential, thus possessing spiritual strength, good personality, self-control, noble character, and wisdom[1].

Physics is one of the branches of natural science that studies natural phenomena around us. According to Mark Hollabaugh, physics encompasses both the big and the small, the old and the new, from atoms to galaxies; physics is part of everyday life[2]. In learning, physics is not just about knowing mathematics; learners are expected to understand the concepts contained within it, understand the problems, and be able to solve them systematically[3]. The study of fluid materials is one of the materials commonly used as the basic concepts of the tools we use in everyday life and requires further explanation, with many learners unable to fully grasp the information related to the material.

The presence of mobile learning cannot replace face-to-face learning in the classroom. The presence of mobile learning is seen as a complement to existing learning and provides students with the opportunity to review what they have not mastered wherever and whenever. Learning media is a very important tool in the learning process; with the presence of media, the learning process will be more interesting than monotonous. In addition, media can increase students' interest and motivation in the learning process. However, in reality, the available learning media are still limited, especially in the subject of physics, where most students do not like the subject[4].

The challenges in teaching static fluid topics frequently encountered by teachers and students include: students often struggle to clearly visualize static fluid concepts, particularly abstract ones like hydrostatic pressure, Pascal's law, and Archimedes' principle[5]–[8]; teachers typically face time constraints that prevent them from covering the material in depth and using adequate teaching aids; traditional teaching methods tend to lack interactivity, leading to decreased student interest and difficulty in grasping key concepts[9]–[11]; students in a single class often have different levels of understanding, making it hard for teachers to address each student's learning needs[12]–[14]; and many schools lack access to laboratories or technological tools that can support the teaching of static fluid topics[15]–[17].

With the development of learning in the concept of electronic learning, mobile learning emerges. The latest technology from mobile-based electronic learning technology. This mobile learning will be used by researchers as a learning media to be developed to assist in the learning process. Based on an interview with a physics teacher at MAN 1 East Lombok, Online learning was felt to be less optimal due to the limited learning media. Learning is done by giving assignments and delivering material by recording it on paper, which is then documented and shared in a WhatsApp group, making it difficult for students to understand the content of the material[18].

Several similar studies that have been conducted related to the development of mobile learning media for static fluid topics or other physics topics include: Development of Android-Based Learning Media on Static Fluid Material[19]–[21]; Mobile Learning Application for Physics Learning on Kinematics[22], [23]; Use of Android-Based Mobile Learning Applications in Physics Learning on Wave Material; Implementation of Mobile Learning in Dynamic Electricity Learning; Development of Mobile Learning Applications for Thermodynamics Material[24].

Another reason students are lazy to learn physics is the excessive use of formulas in its application. If only conventional methods are used, students will be bored and tired because they only see it in the form of print media consisting of very stiff and difficult-to-digest language concepts. Educators must use media to change students' mindsets.

One way to change this mindset is by utilizing one of the media that has now become a friend of students, namely by using Android. With the presence of learning material on each Android, students are more interested in learning and will not feel burdened by books or laptops that they have to carry, ultimately leading to an increase in student learning outcomes. Android is one of the rapidly developing mobile operating systems. Android is an open-source operating system, which means it is free and can be used freely by application developers[25]. Android has advantages such as giving developers the freedom to create their own applications.

From these problems, researchers try to offer a solution by using Android-based learning media, which has the advantage of being more interesting and can be used anywhere and anytime. This reality has led to the need to develop a smartphone program/application that can facilitate students in learning physics, so that students can use the application as a source of learning physics anywhere and anytime. Therefore, through this final project, researchers are motivated to develop a physics learning application on Android smartphones for high schools. Learning through smartphone media will be more practical, allowing students to learn anywhere and anytime, thus making it easier for them to learn.

METHOD

The type of research used in this study is development research (Research and Development), namely the development of Android-based learning media on static fluid material at MAN 1 LOTIM. The research procedure adapts the ADDIE development model, which consists of four stages:

Analysis, Design, Development, Implementation, and Evaluation[26]. The sampling technique used is purposive sampling for small group testing and large group testing.

The validity test of the Android-based learning media development on Fluid material is conducted by competent validators, namely media experts and material experts[27]. Furthermore, the validators are asked to provide general assessments and suggestions for the developed Android-based learning media, whether the developed Android-based learning media can be considered valid or not valid, and effective or not effective.

Qualitative data, such as comments, suggestions, and revisions from media and subject matter experts collected through questionnaires, are qualitatively analyzed and used as feedback to improve or revise the developed product. Additionally, quantitative data, including scores from media and subject matter experts, are converted using a Likert scale ranging from 1 to 5, The table presents the conversion reference.

Table 1.
Guidelines for transforming quantitative data into qualitative data[28]

Value	Quantitative data	Qualitative data
A	$X > 4.21$	Excellent
B	$3.40 < X \leq 4.21$	Good
C	$2.60 < X \leq 3.40$	Fair
D	$1.79 < X \leq 2.60$	Poor
E	$X \leq 1.79$	Very Poor

$$P = \frac{\sum X}{\sum Xi} = 100\% \quad \text{.....[29]}$$

This research involves collecting two types of data: quantitative and qualitative. Quantitative data includes validation scores from experts and responses from teachers and students through questionnaires. Qualitative data consists of comments, suggestions, and evaluations from subject matter experts, media experts, teachers, and students.

Learning Media Validation

The validation of learning media is determined by the average scores from expert questionnaires, indicating the suitability of the media for field use. This data is gathered from questionnaires distributed to media and subject matter experts. Experts' evaluations are converted into quantitative data using a Likert scale. If the average score is considered good and their comments and suggestions have been addressed, the media is deemed valid.

Respondent Data Analysis

Data collected from teacher and student assessments are analyzed in a similar manner to data from subject matter and media experts. If the average score from respondents indicates suitability, the media is deemed practical for use.

RESULT AND DISCUSSION

The development of Android-based mobile learning media for Physics adheres to the Research and Development ADDIE research procedure, which includes the Analysis, Design, Development, Implementation, and Evaluation stages[30].

Analysis Phase

In the analysis phase, there are two stages. The first stage involves needs analysis, which includes understanding the students' requirements. It was discovered that students struggle with understanding static fluid material due to limited learning resources. Hence, there is a necessity to explore alternatives to aid students in comprehending the material, such as developing Android-based learning tools. Hardware requirements include the minimum specifications needed for developing learning tools, such as a 64-bit Windows 10 operating system, Intel processor, 4 GB RAM, and a 1 TB hard drive[31]. Software requirements encompass the necessary software for developing Android-based learning

tools, such as Unity 5.6, MonoDevelop, and CorelDraw X7. Smartphone specification analysis includes determining the minimum specifications required for smartphones to run the learning tools smoothly, such as Android Lollipop, 1 GB RAM, and 8 GB memory.

The second stage involves competency analysis, which includes curriculum and core competency analysis using the 2013 revised 2017 curriculum and core competencies, analysis of basic competencies, competency achievement indicators, and core material of static fluids.

The Design Phase

The design of the instructional material in this learning media starts with aligning subtopics with basic competencies and competency achievement indicators. Subsequently, the instructional material model is divided into three parts: sub-material sections, instructional videos, and practice questions.

The selection of the subject "Static Fluids" for this study, which is part of the first semester curriculum for eleventh grade as per the 2013 revised curriculum, is based on the challenges identified in teaching this topic. These challenges were revealed through preliminary research, which included interviews with physics teachers, as well as analysis of student grades and surveys.

The video instruction section includes two educational videos in the Android app: one on static fluids and the other on real-life applications of static fluids. The practice questions include 20 items on static fluids: 5 multiple-choice questions on static fluid concepts, 5 on static fluid laws, and 10 on applying static fluids in daily life.

Interface design is the layout plan of the learning program, encompassing font, button, background, and menu designs. The buttons include a home button with a house icon, a next button, and a back button, each serving specific functions. Home returns to the main page, next proceeds to the next page, and back navigates to the previous page. Revisions and improvements are made as necessary to meet the needs of both teachers and students.

Figure a. Interface Design Display

Figure b. Menu Page Display

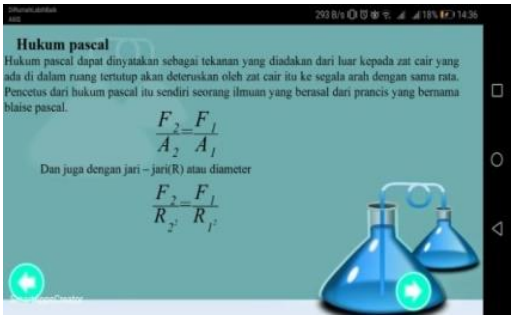

Figure c. Learning Content Display

Figure d. Display of Instructional Videos

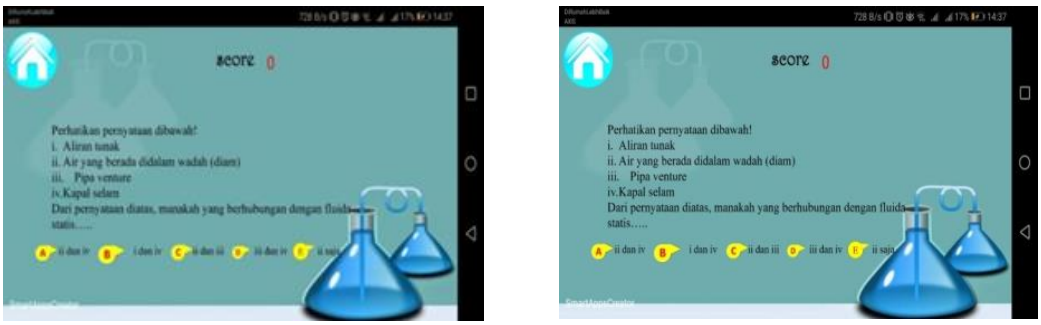

Figure e. Exercise Question Display

The design stage (figure a) is divided into three phases. The first phase involves designing the instructional media, including creating a flowchart to ensure all activities within the media run correctly. It also includes storyboarding, which consists of various parts such as the home page, main menu, basic competency, content, video, and evaluation pages. The second phase is the development of assessment instruments for the instructional media. The third phase involves developing the content, where using color in presentation can positively impact students' short-term memory and serve as an alternative to enhance their cognitive abilities[32]. This phase includes static fluid material, instructional videos, and material evaluation.

In the development stage (figure b), there are two phases. The first phase involves developing instructional media, including steps such as creating layout and navigation buttons using CorelDraw X7, scripting, and converting the instructional media into an application (apk). The content presentation includes static fluid concepts (figure c), the laws of static fluids, and the application of static fluids in everyday life. And The instructional video section (figure d) comprises two videos: one providing an explanation of static fluids and the other demonstrating the application of static fluids in everyday life. The evaluation interface in Figure d, presents multiple-choice questions with five possible answers. Users can select an answer by clicking on it and immediately see whether their choice is correct or incorrect.

The implementation phase follows the development phase. During this stage, all media designs that have been developed are validated by media and subject matter experts, then applied after revisions. However, during this phase, the researcher conducts product testing with small and large groups (large-scale testing) to gauge the responses of teachers and students to the developed instructional media. These tests are intended to assess the practicality of the media. The limited testing involves one subject teacher and 34 students.

The evaluation phase marks the culmination of instructional media development. It builds upon the preceding implementation stage of the media application, ensuring that all features across the application's pages function seamlessly, without any hindrances or errors, and in accordance with the initial design from earlier stages. This guarantees that the instructional media application is ready for use in learning activities[33].

Tabel 1. Expert and respondent validation results

No	Validation/responden	Maximum Score	Total Score	Average Conversion Score	Category
1	Subject Matter Expert	75	60	4	Good
2	Media Expert	90	82	4.5	Good
3	Teacher	70	52	34.3	Very Good/Effective
4	Student	-	1759	4.31	Very interesting

Based on the table, the instructional material validation results for the Android-based mobile learning media were conducted by one lecturer. It was found that the developed instructional material was categorized as "Good," scoring a total of 60 out of a maximum of 75 points. The average score was converted to a Likert scale of 1-5, resulting in a score of 4 out of 5. Therefore, it can be inferred from this data that the developed instructional material is considered valid, allowing for testing of the developed media. And validation of the Android-based mobile learning media by lecturer categorized it as "Good," scoring 82 out of 90. Converted to a Likert scale of 1-5, it received an average score of 4.5 out of 5. This indicates the media's validity for further testing. It is advised that the content and evaluations align with the learning objectives to ensure students achieve optimal results.

The research progressed through various stages, starting with small group testing of the Android-based mobile learning app. This phase involved ten students from class XI at MAN Lombok Timur, including six high-achieving, two moderate, and two lower-achieving students. The app was applied to these students, who then provided feedback through questionnaires and comments. Despite being deemed highly practical, student feedback prompted improvements, particularly in the evaluation questions' variety and quantity. Post-improvements, the app was found to be valid and highly practical, ready for field testing. The field test involved 34 students from class XI at MAN 1 Lombok Timur, aiming to gauge the app's potential effects.

During the test, students were divided into groups to discuss the material presented via the app. The group with the best answers was rewarded.. The student responses were collected and averaged, with the app scoring 4.3 out of 5, indicating its quality. Overall, the ADDIE method ensured a well-developed app suitable for enhancing learning activities in schools[34].

The development of Android-based learning media for IPA static fluids underwent three assessments: validation by media experts (rated good), validation by subject matter experts (also rated good), and feedback from teachers and students during app use (rated good). This feedback demonstrated the app's ability to improve student engagement and learning outcomes.

Mobile learning is a contemporary advancement in educational technology that caters to students' learning needs[35]. This learning medium facilitates comprehension and makes learning more dynamic and appealing. According to Surahman (2019), mobile learning offers a solution to issues of educational access and equality. In this study, multimedia learning based on Android smartphones was developed to creatively explain static fluid material, utilizing text, images, videos, audio, and animations.

The research findings, as a novel innovation, demonstrate that students can utilize the Android smartphone-based mobile learning application in their learning processes. The application's strengths include an appealing interface and user-friendly nature. However, its drawback lies in its reliance on smartphone applications, which limits content and operating system capabilities.

CONCLUSION

The research and development process involves several steps: Analysis, which identifies field problems; Design, planning materials and media; Development, creating the product; Implementation, validating and testing the product on a limited scale; and Evaluation, making final adjustments based on feedback from teachers and students.

The validation results from media and subject matter experts, as well as feedback from teachers and students, showed a total score of 1,953 or an average of 4.27, indicating a "Good" categorization. Therefore, based on the validation results and overall feedback, it can be concluded that the Android-based mobile learning media for set theory is considered "Highly Suitable" for use in the learning process. The mobile learning media was also found to be practical, as indicated by student responses, suggesting it was suitable for use in the learning process.

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