

# Development of physics mobile learning media in optical instruments for senior high school student using android studio

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**Abstract.** Physics learning requires good media in order to convey the relation of physics with everyday life. Lesson material delivered in the form of multimedia is accepted by students better than material in the conventional form. Smartphone-based media is one of the breakthroughs that can be implemented into physics learning. The purpose of this study is to produce an Android-based physics mobile learning media product that are valid and feasible for use in learning. This research is a Research & Development study with procedures adapted from the 4-D model. Based on the results of the development, obtained an Android-based physics mobile learning media product on the Optical Instruments material. The product was developed using the Android Studio 3.2 IDE at the minimum level of API 14 Ice Cream Sandwich. Media products are declared valid and can be used in physics learning with expert assessment results on the Very Good criteria.

**Keywords:** *physics mobile learning, optical instrument, android studio*

## 1. Introduction

Changing times demand changes in all aspects. Learning activities need to be adapted to the character of the nowadays student. Millennial generation students cannot be equated with students from the previous generation. Today's learning needs to pay attention to the media used, especially on subjects that require real examples in everyday life. One lesson that discusses the events or phenomena that occur in everyday life is physics. Thus, learning physics requires a good delivery so that the suitability of physics with life can be conveyed. Physics in everyday life can be more practically delivered with the support of technology. Multimedia through information technology plays an important role in learning physics. Students who receive learning by using multimedia get better learning outcomes [1], [2]. Lesson material delivered in the form of multimedia is accepted by students better than material in the conventional form.

Advances in technology are developing rapidly to support the high mobility of its users. Smartphone becomes one of the devices that strongly supports mobility. Full-featured smartphone with a relatively small size is easy to carry anywhere. Equipped with internet connectivity, smartphones are even able to exchange information non-stop for 24 hours a week. Thanks to the advantages in it, internet users prefer



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to access the internet through their smartphones compared to using a computer or other device [3]. This makes smartphone as a communication tool that is very easy to find.

The application of technology in learning can offer effectiveness, variety, and enjoyment in learning [4]. Smartphones work like a computer, so that in some situations the use of multimedia on a computer can be replaced with a smartphone. The features available in smartphones can be used to help students learn [5] - [7]. Smartphones have the potential as a learning medium that has mobility, time-saving, environmentally friendly, and interactive [8]. Smartphone-based media can also play an important role in motivating students' curiosity and interest in learning physics more [9] - [11]. However, besides helping, smartphones can also be a source of interference in learning [5], [7]. The use of smartphones without a clear direction of learning is one example of obstacles in the learning process [6]. Still, this can be prevented or minimized by the teacher's role in making regulations and conditioning students to comply with these rules. With proper handling the use of smartphones in learning does not always cause disruption to students [9].

Smart phones run with certain operating systems, one of which is Android. The Android operating system is the most popular operating system used on smartphones. Android is open source and has the capability of customization from various parties, so the creations in it can be unlimited [12] - [14]. This operating system also provides the reliability and portability of high-level programming languages and also API (application programming interfaces). Until now, android continues to grow, so does the development tool [15]. There are several Android application development tools/Android Integrated Development Environment (IDE), one of the most widely used is Android Studio [13]. Android Studio is the official Android application development tool that is recommended and directly supported by Google [15]. The features included in Android Studio enables development of highly varied applications, including the development of learning applications.

Android learning media development has been done a lot, one method is to use online development facilities [16] - [18]. Online development platforms usually offer application development without the need of coding, so the process of making an application can be done more easily. However, applications resulting from online development have limitations on features that only have limited options. Another method in developing android-based physics learning applications is to use Adobe Flash [19] - [22]. The Adobe Flash program has many features that enable the development of highly interactive media with coding support using ActionScript. The coding facility in Adobe Flash enables development that is more stylish and flexible compared to the facilities provided in the online application development tool. Nevertheless, the Adobe Flash output application can only run on android mobile devices that have Adobe AIR for Android installed [23]. This becomes a weakness because the application developed depends on other applications to be able to run, so the application will be more difficult to disseminate. Furthermore, Adobe AIR that must be installed on smartphone increases the storage memory capacity that must be provided. The limitations of online development tools and Adobe Flash for android applications can be overcome by using development tools that have facilities to use coding and can be run without the addition of other programs. Android Studio offers unlimited development possibilities because all components in the application can be developed without being bound by certain templates.

Android Studio IDE is used in this study as a solution to the limitations of online-based development tools and the limitations of Adobe Flash which requires the Adobe AIR application to be installed on mobile phones. Applications developed using Android Studio are published in the .apk file extension. The file can be distributed and installed on an Android device according to the level of development API without the need for other third-party applications. Another thing that must be considered in developing Android applications is the version of Android that is used [13]. Android in each version has different features and APIs. The higher API level has more complete and new features. Applications

with the latest API levels can only be run on devices with the Android operating system at that API level. In this research, media products are developed using API level 14 Ice Cream Sandwich. The reason is because Google Developer data shows that applications at this level can run on all active Android devices in the world. By using these features, the aim of this study is to develop an Android-based physics mobile learning media in optical instrument subject that is feasible to be implemented in physics instructions.

## 2. Research method

This research is a Research and Development (R&D) research that aims to develop a product and test the feasibility of the product. The procedure in the study was adapted from the 4-D model developed by Thiagarajan [24]. The stages in this research are limited until the validation of media products, which is done in the Developing stage. Thus, the research stages are consisted of: 1) Defining; 2) Designing; and 3) Developing.

The product developed in this research is a physics learning media that runs on the Android platform with Optical Instruments material, namely Eyes, Glasses and Magnifier. Validation procedures are carried out by involving expert in Physics Education. Validation is performed on aspects of software engineering, visual communication, and materials. The results of filling in the validation sheet are averaged to obtain a media feasibility score. The higher validation score indicates better level of validity and quality of the development product. The feasibility score of the validation results are interpreted using the criteria in table 1. Criteria are obtained using the ideal standard deviation equation.

**Table 1.** Range of assessment criteria

No	Score Interval	Criteria
1	$\bar{X} > 81,6$	Very Good
2	$67,2 < \bar{X} \leq 81,6$	Good
3	$52,8 < \bar{X} \leq 67,2$	Pretty Good
4	$38,4 < \bar{X} \leq 52,8$	Not Good
5	$\bar{X} \leq 38,4$	Bad

## 3. Results and Discussion

The result of this study is an Android-based physics mobile learning media. Media was developed for physics material in optical instruments including eyes, glasses, and magnifying glass. Product development aims to help teachers facilitate learning and increase the options of learning media. The mobile character of the product also allows the use of media outside the classroom. Thus, in its use, the media can be used at any time by students as long as there is access to their smartphone.

The stages in this study are limited to product validation at the Developing stage. This is done in accordance with the research objectives to produce an android-based physics mobile learning media product that is valid and suitable for use in learning in accordance with the validator's assessment. A complete description of the steps in development is as follows,

- 1) Defining, in this stage the, school observations, curriculum analysis, and literature review are carried out. The observation was conducted at one school in Sleman, Yogyakarta. Observation activity aims to find out how the conditions in the field so that it can create products that will be applicable and in accordance with needs. Curriculum analysis is related to the suitability of the curriculum and

analysis of the material to be made in the media. The results of curriculum analysis indicate that the optical instruments material is suitable to be developed. Furthermore, a literature review is conducted to explore references about the media and material to be developed.

- 2) Designing, at this stage the media layout is designed and the features that will be available in the media are designed. The resulting product specifications are adjusted to the results in the previous stage. Content planning in the media, namely material, pictures, videos, discussion material, discussion videos and evaluation grids are prepared.
- 3) Developing, this stage is the production stage of each design that has been compiled in the previous stage. The entire content is created in digital form. Physics material that has been equipped with pictures and equations is made in html format. The discussion material is in the format of images, and the videos are converted to small size MPEG4 format. Hereafter, the application is created by using the Android Studio 3.2 IDE using XML and Java programming code. Display or layout is made according to the design using Android XML. Navigation and interactive features are built using Java code. After the product is created according to plan, a validation sheet is created to validate the media according to the indicators that have been designed. The validation phase is carried out to determine the feasibility of the developed learning media. This stage involves the Physics Education expert as validators.

**Table 2.** Product validity results.

No	Aspects	Score	Criteria
1	Software Engineering	21	Very Good
2	Visual Communication	15	Good
3	Materials	48	Very Good
	Total	84	Very Good

The validator assessment of the developed learning media product is presented in table 2. The results of the validation of the Android-based physics mobile learning media are declared valid with a total feasibility score of 84 on the Very Good criteria. Thus, media products are declared eligible for use in physics learning based on validator ratings.

The developed physics mobile learning media in optical instruments has a main menu that contains seven features namely instructions, competencies, materials, discussions, sample questions, evaluations, and developer profiles. The overall features provided in the application are intended in order to integrate the learning process in one application. So, in addition to providing material, the application is made so that it also provides discussion and evaluation material to support the learning activities. Research by Nanda & Wilujeng [25] resulted in an android learning application on optical instruments that is more complete, but is not equipped with discussion, evaluation and discussion of example problems. Then another study by Permana [22] also developed a flash-based android application on optical instrument material with a wider range of material, but did not contain features for discussion and did not display any video. Based on these results, the media development in this study was made as a media that has more complete and more flexible features in its distribution because it is not based on Adobe Flash. However, it is narrower in terms of the scope of the learning indicators in the material, that is, only in the matter of eyes, glasses, and magnifier.

In the application, the buttons on the main menu as presented in Figure 1 will direct the user to a new display or activity according to the keys pressed. The Instruction option contains a description of the

button or menu in the application. This feature aims to provide basic information about the application so that users have an understanding of the buttons and icons presented. The button is also placed at the top of the menu so it would be the first button seen by the user. The Competencies page contains information about core competencies, basic competencies, and optical instruments learning objectives. This information aims to make students know what is contained in the application and the targets or achievements that they must have. The next menu is the Material button which directs the user to the display that contains buttons for material about eyes, eyeglasses, and magnifier. Three buttons in this material sub menu if pressed will lead to a description of each material. The material is presented in portrait and can be scrolled up and down to read the material. The contents of the material are equipped with pictures and relevant equations for each material topic. Figure 2 shows the contents of one of the topics in the material, namely the eyes.

The Discussions contains the issues that are subject to discussion of students in groups, this menu has an entrance page that requires students to enter the code. The code is intended to make it easier to work in groups, so that what is displayed on the Discussion page is in accordance with the group that has been grouped by the teacher. Each discussion group was faced with one problem, with a total of five problems for five groups. Figure 3 displays the discussion entry page on the application.

The 5<sup>th</sup> menu, the Sample Questions, will take the user to a new look that lists five examples of multiple-choice questions. The list as presented in Figure 4 is a button which when pressed will open a video discussion of answers to the problem. The discussion video can support students to learn the process of solving problems in questions more deeply because they can be played back freely by students. The discussion of the questions is also equipped with narration, so students can capture information both visually and audio. The feature shown in Figure 5 is expected to be able to present the same impression as when students receive explanations on the discussion of questions from the teacher in front of the class. In general, video media are already commonly used in android-based learning media applications, but are more likely to be used to convey material explanation [16] - [18], [21]. Media development results in this study are not equipped with a video that contains an explanation of the material, but specifically only as a discussion for example problems. These steps are taken so that the application size can be made to a minimum. Applications that are equipped with more videos will have a larger size storage requirement.

The Evaluation Menu contains 5 item evaluation questions. This menu is also equipped with an entry page that requires students to enter a code. The use of the code before being able to open the evaluation menu is intended so that students do not open and knowing the answer of the questions in it before the evaluation time. Specifically, after students enter this menu, they cannot press the back button until the time limit for working on the questions is up. This feature is expected to minimize the students opening other menus related to the material, so that they really do the problem independently without seeing the material or sample problems. However, students can still exit the Evaluation page by forcing the application to exit using the multitasking button. This weakness may be overcome in further development by disabling the navigation buttons (back, home, multitasking) if possible. This step will certainly reduce distraction because students cannot access other applications besides the learning media application that is being opened. Instructions and rules from the teacher as well as prevention features from interference on the application will certainly support learning activities positively [6].



**Figure 1.** The main menu display of the application shows the buttons that contain icons and text from seven menus in the application.



**Figure 2.** The eye material display displays the physics material of the eye that is accessed through the Material menu and eye sub menu.

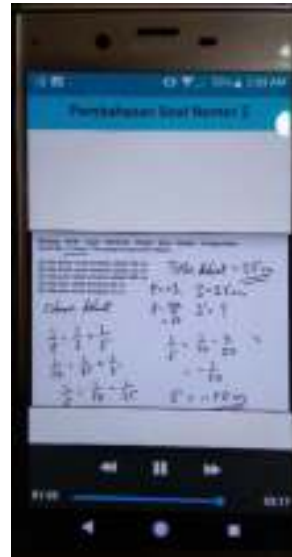


**Figure 3.** The discussion entry page display shows a form to enter the discussion code which then leads to the discussion sheet.



**Figure 4.** The sample questions menu contains five items of multiple-choice questions which, if pressed, will lead to a page containing a video about the questions.

**Figure 5.** Display of the video about the questions on the Sample Questions menu. The video will immediately play if one of the 5 items on the sample question list is pressed. Video is equipped with control features so that users can freely play back.



#### 4. Conclusion

Research has been carried out to obtain an Android-based physics mobile learning media on optical instruments namely eyes, eyeglasses, and magnifier. Product creation is done using the Android Studio 3.2 IDE with a minimum API level of 14 Ice Cream Sandwiches, so that the product can run on Android version 4.0 Ice Cream Sandwich or newer. Media products are declared valid based on expert validator ratings with a score of 84 and Very Good criteria. Thus, the product of development is feasible to be used in physics learning.

Further research can be conducted to investigate the validity and feasibility of the media empirically after it is implemented in classroom learning. More extensive development can be done by expanding the scope of physics material in the media as well as adding other features that support better learning.

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