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Android-Based Physics Learning-Media Apps for High School Students

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Abstract. The use of Android smartphones has been emerging quite fast. It distracts most of the students' attention from their studies. While at one side, it brings some negative impacts on students, on the other hand, it opens some opportunity to use the students' deep engagement with Android smartphones as a source of excitement to promote physicslearning-media. We have conducted research in Surabaya (Indonesia) and its vicinity to address the use of Android smartphones as student physics learning source. Applying the 4-D model, we have developed Android mobile-apps based physicslearning-media on several topics of introductory high school physics. The physicslearning-media have been tried out by several groups of students and have received positive comments from the users.

1. Introduction

The advancement of information and communication technology (ICT) is very impressive [1]. First, the birth of the world wide web supported by the improvement of data processing speed and internet bandwidth has changed modern human civilization significantly. As the approaching of the fourth industrial revolution [2], more and more advanced social aspects, that once were considered private now become public. Second, the increase of accessibility use of Android smartphones adds another influence of ICT to human civilization [3]. Many things that once were thought impossible to happen, now we can witness their occurrence. The use of ICT in education has been around for some time. In line with the theory of learning that signifies the use of multimedia in enhancing the impact of learning [4], ICT-based multimedia has become one of the most extensively used in education.

The vast increase in smartphone usage in Indonesia [5], especially the Android ones, is quite amazing. In many aspects, it brings more convenience, causing many people, including youngsters and students, addicted to using Android smartphones [6]. It has taken too much time for the students. It becomes a warning alarm that we need to address. While on the one hand, it causes some weary, it also opens some opportunity to use the students' deep engagement to Android smartphones as a source of excitement to promote physics-learning-media. Nowadays, plenty of cool things can be accessed by smartphones by downloading appropriate apps from the play store. Unfortunately, very few of the available apps in the Play store dedicated to physics learning-media, especially in the Indonesian language. This fact was the main reason to do the research reported in this article. Besides, mobile apps have some advantages compared to web-based learning-media in terms of practical use. A device accessing a web-based leaning media must continuously connect through the internet to the website (host) of the learning-media. On the other hand, to access mobile app learning-media, the accessing device only needs an internet connection to download the corresponding mobile app to the device. Once downloaded, no need for an internet connection to run the application, except for online tests, for example.

The main topics of the high school physicslearning-media presented in this report covers most of the high school physics topics in the tenth grade, namely measurement (pengukuran), linear momentum and impulse (momentum danimpuls), simple harmonic motion (gerakharmoniksederhana), linear motion (geraklurus), parabolic motion (gerak parabola), and circular motion (gerakmelingkar).

2. Methods

We chose Research and Development method as the framework of this research. Specifically, the 4D model [7] consisted of four stages: *define, design, develop*, and *disseminate* were applied sequentially. In the *define* stage, we did needs and concept analyses and determined the selected topics in the learning-media. In the *design* stage, the main features of the learning-media were determined to fit the purpose. In the *develop* phase, starting from the first selected topic, the components that constituted each feature would be built up. Once the elements considered complete, they will be put in the relevant feature to form a learning-media of a particular topic. At the end of this stage, the developed learning-media would verify by media and content (physics) experts and then tried out by prospective users. The last stage, *disseminate,* was meant to run a final test on the developed learning-media and present it to a much broader user.

As has been stated, developed learning-media was meant to access via Android smartphones. Therefore, specific software would be selected to comply with Android smartphones. As a means of research instruments, we would develop evaluation sheets equipped with corresponding rubrics, sets of questionnaires, and pre-test-post-test on each topic.

Due to the characteristic of the collected data, we will analyze them with descriptive statistics. The evaluation of the media would focus on the four aspects: appearance, topic (physics) content, learning, and practicality. Similarly, the questionnaires for the users could be clusters into four aspects. The average of the scores on the expert evaluation as well as for the users' response will be stored. We will interpret the average score on a 4-scales using the collected data by using table 1.

Table 1. Category conversion for the average score on 4-scales.

Average score	Category	Attribute
$\bar{x} > 3.4$	A	Very good
$2.8 < \bar{x} \leq 3.4$	B	Good
$2.2 < \bar{x} \leq 2.8$	C	Sufficient
$1.6 < \bar{x} \leq 2.2$	D	Bad
$\bar{x} < 1.6$	E	Very bad

We will use gain test to measure the usefulness of the learning-media as an independent learning source.The data collected from the pretest and posttest would be used to calculate the gain, defined as the difference between the posttest and pretest scores. The gain tests, then, will be analyzed by calculating its normalized gain score, g, [8] which is defined as the ratio of the average gain test and the difference between the maximum score and the average of pretest score, as shown in equation (1).To interpret the normalized gain score, then we will use the conversion table 2. [9].

$$g = \frac{average\ of\ posttest\ score - average\ of\ pretest\ score}{maximum\ score - \ average\ of\ pretest\ score} \quad (1)$$

Table 2. Category conversion for interpreting the normalized gain score.

Normalized gain score	Attribute
g>0.7	High
0.3<g ≤ 0.7	Medium
g <0.3	Low

3. Results

This article presents the implementation progress of the first two-year research. Following the methods described above, the current progress of the research can be summarized as follows:

3.1. Define stage

After completing needs and concept analyses on the list of topics covering the tenth grade of high school physics curriculum, we decided to select 8 topics: measurement, linear motion, parabolic motion, circular motion, linear momentum and impulse, simple harmonic motion,work and energy, and Newton's law of gravitation.Each topic will be developed independently in separate learning-media. Three topics were covered in the first-year development, another three topics are being developed in the second year, and the rest will be developed in the third year.

3.2. Design stage

There are plenty of software that can be used to develop interactive learning-media. For the sake of familiarity and practicality we chose Adobe Flash CS6 as the main software supported by Adobe Premiere, Adobe Illustrator, Adobephotoshop to develop mobile app learning-media.

Due to the independent characteristics of each learning-media, each of them had to be self-contained. Therefore, each learning-media must include the following main features: introduction; main topic content; solved problems; exercises; and simulation experiments. Furthermore, each leaning media must include a manual on how to operate it.

In the first year, the topics of measurement, linear momentum and impulse, and simple harmonic motion were completed. Currently, the second year, the design stage of another three topics: linear motion, parabolic motion, and circular motion has been completed.

3.3. Develop stage

There are six modules of Android apps physics learning-media gone through the develop stage. All of them had been reviewed by media and physics validator experts. Each of the evaluated aspect at least have score of 3.5 that has a very good attribute. The range of the evaluation scores and the corresponding attribute can be seen in table 3.

Table 3. Range of experts' evaluation scores on four evaluation aspects.

Evaluation aspects	Range of evaluation scores	Attribute
Learning instruction	3.5 – 3.8	Very good
Topic content	3.6 – 3.8	Very good
Appearance	3.6 – 4.0	Very good
Implementation	3.5 – 3.8	Very good

After being revised according to the experts' comments, each learning-media was tried out by randomly chosen students at the Physics Education program. At some other time, the same learning-media was tried out by senior high school students. By the end of every try out, each participant was

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asked to respond to the given 4-scale questionnaires. Table 4 and table 5, respectively, summarize the response of the students of Physics Education program and senior high school students.

Table 4. Physics Education students' response on three evaluation aspects.

Evaluation aspects	Range of response scores	Attribute
Learning instruction	3.3 – 3.7	Good – Very good
Appearance	3.3 – 3.5	Good – Very good
Implementation	3.4 – 3.6	Good – Very good

Table 5. Senior high school students' response on four evaluation aspects.

Evaluation aspects	Range of response scores	Attribute
Learning instruction	3.3 – 3.6	Good – Very good
Topic content	3.3 – 3.4	Good
Appearance	3.3 – 3.6	Good – Very good
Implementation	3.4 – 3.7	Good – Very good

The first three topics of learning-media had been tried out by the senior high school students as the prospective users. Those students had taken pre-test and post-test, and the normalized gains in each group related to the learning-media had been analyzed. The results ranged from 0.33 – 0.74 which can be attributed as medium to high.The other three topics of the learning-media, the linear motion, the parabolic motion, and the circular motion still have to wait for the try out by senior high school students until October2019 due to the arrangements that have been made by the school administers.

To get the picture of the Android-based physics learning-media that we have developed, we present several snapshots of them as shown in figure 1-6.Figure 1 represents the opening features of the simple harmonic motion learning-mediaconsisting the layout of the front-page appearance, coverage of the main menu, and the manual on how to operate it. Figure 2 depicts the simulation experiment on the topic of linear momentum and impulse. Figure 3 illustrates the sampling of learning material relevant to the topic of measurement.

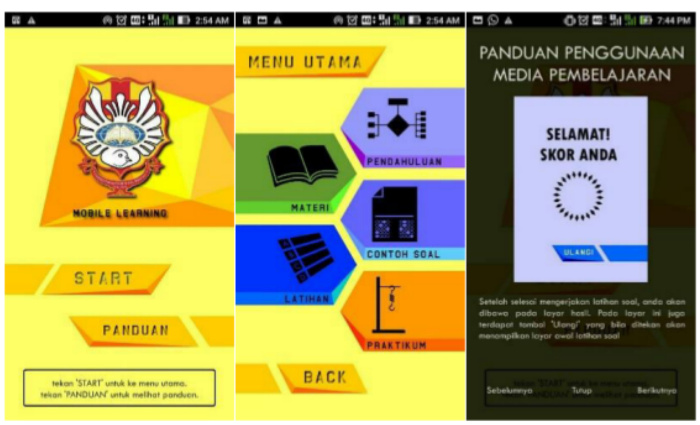

Figure 1. The opening features of the simple harmonic motion learning-media.

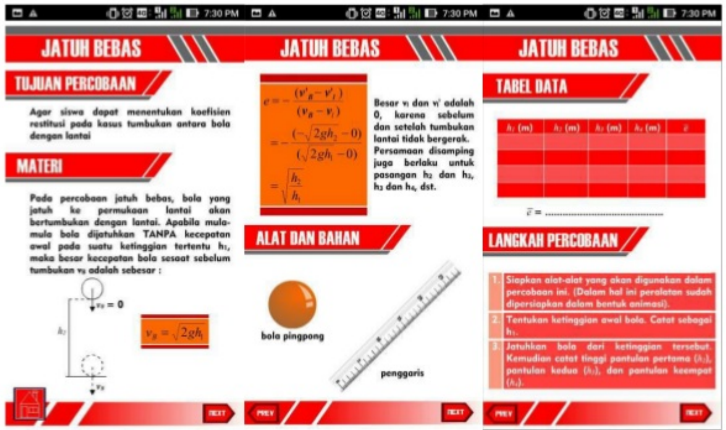

Figure 2. The experiment features of the linear momentum and impulse learning-media.

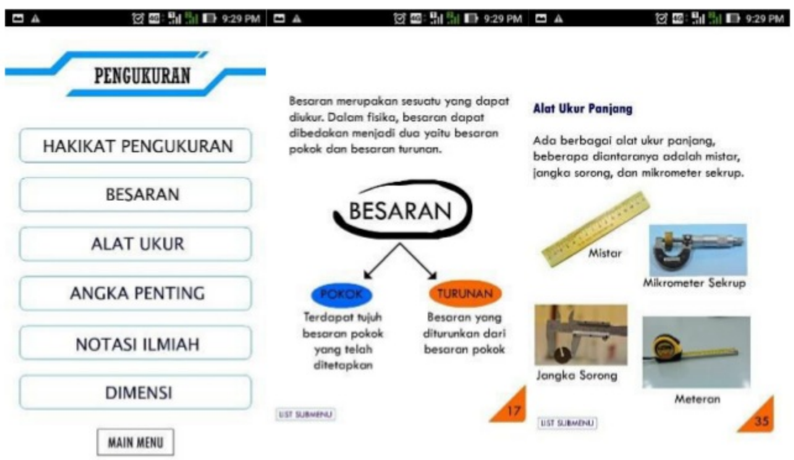

Figure 3. The topic content featuresof the measurement learning-media.

Figure 4 describes the mixed snapshots of the circular motion learning-media. It consists of the manual on how to operate the learning-media, the main parts of learning-materials covered in the learning-media, and the preface of solved problems. Figure 5 shows simulation experiments on the topic of linear motions consisting of uniform linear motion (GLB in Bahasa Indonesia) and linear motion with constant acceleration (GLBB in Bahasa Indonesia). Figure 6 illustrates the introduction features consisting of the learning goals and map concepts in the topic of parabolic motion.

Figure 4. The mixed features of the circular motion learning-media.

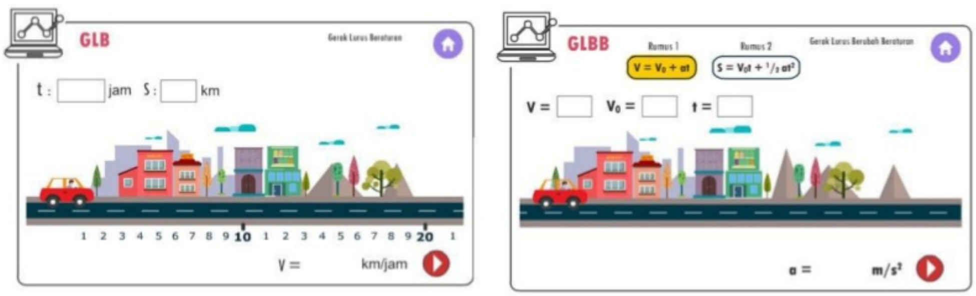

Figure 5. The simulation experiment features of the linear motion learning-media.

Figure 6. The introduction features of the parabolic motion learning-media.

4. Discussions

We have developed six separate Android-based learning-media covering most of the tenth-grade high school physics. All of them had passed the expert judgment with very good attributes on every aspect, as can be seen from table 3. Getting very good attributes in every evaluation aspect did not mean that the learning-media had been perfect. We had to make several revisions and adjustments before we obtained those attributes.

While three of the six learning-media are still to be tried out by senior high school students next month, the other three had been tried out and could be analyzed. Upon the completion of the three selected topics that have been tried out by senior high school students, we found out that students enthusiastically accepted the learning-media. Although similar learning-media can be found through the internet, they are not in the mobile app format that can be downloaded and be used anywhere and anytime. As can be seen from tables4 and 5, the students' responses are generally varying from good to very good, except on topic content which is in the good range. Both students from the Physics Education and senior high school gave a similar response to the learning instruction, implementation, andappearance aspects. Both groups of students are millennial students that share many things in commons. The fact that the learning-media we developed received somewhat lower attributes from the students was due to the communication language we used in the developed learning-media.

Based on the normalized gain score on their post-test pre-test scores, which is in the range of 0.33 – 0.74, we can conclude that the learning-media we developed can be effectively used as an independent learning source. The additional data next month will be able to confirm whether or not we need to revise this conclusion.

5. Conclusions

Android-based physics learning-media apps seem to have a good acceptance by the prospective users - senior high school students. This conclusion was supported by the students' response to the given 4-scale questionnaire distributed upon the completion of the learning-media uses. Based on the available data, the normalized gain score, which represents the improvement of the students' cognitive understanding about the relevant topic, the learning-media can effectively serve as an independent learning source.

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