

The development of android-based physics comic on optical devices for high school students

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Abstract. This research aims to (1) produce an android-based physics comic learning media on optical devices about eye and camera (2) examine the value of feasibility of android-based physics comic learning media on optical devices about eye and camera. This research uses ADDIE model. The model consists of five steps; (1) *Analysis*, this stage aims to analysis the problem, (2) *Design* start to design product that will be developed according to the results of the needs in learning analysis, (3) *Development*, the process of creating and developing product according to design, (4) *Implementation*, the stage to use the developed product (5) *Evaluation*, to improve the product based on criticism and suggestions from the questionnaire responses done by respondents after using the developed product. Validity of the instrument is counted by the percentage agreement through the validation eye and camera of media expert, material expert, and questionnaire responses of respondents. The results of these research and development are (1) produce an android-based physics comic learning media on optical devices about eye and camera (2) the developed media own a high score of feasibility with a very good predicate. This shows that the developed learning media is feasible to use in learning.

Keywords: *physics comic, research development, android, optics*

1. Introduction

Physics studies phenomenon or symptoms that occur in nature and analyze how the symptoms occurred. The physics theory varies based on the level of education. There are many theories with the abstract concept in high school. This abstract physics concept causes students experience difficulties in understanding the physics theory [1], [2]. The problem of learning physics is on the learning process which tends to only sharpen the aspects of remembering and understanding that cause students to be passive and have limited thinking ability so that it inhibits the development of their thinking [3]. The lack of varieties and contextual in learning also cause the students learning outcomes in learning physics are still low [4], [5].

The development of communication and information technology brings out such facility as a method of learning which is considered as solution to suppress the problems in learning. This development of technology is used by educators to solve the education problems [2], [6]. Comic is presented in the form of cartoons which express the character, who run the story in a sequence that is closely related to the image [7]. Here, comic are made with coherent and orderly story line that make it easier to remember, so that students are interested to read it [8], [9]. Comic as a media can be used independently by student and teacher as alternative device to support the learning process in class [10]. Comic media is effective



to improve student comprehension [11]. There is an increase of analytical thinking and scientific attitude of student after using science comic media [12].

Physics learning is more fun if the subject matter is packaged in the form of a picture comic book, especially in visualizing the abstract physics concept [13]. The picture can overcome the constraint of space and time because not all things, objects or events can be brought to class as well as student who cannot always approach the objects or events [6], [14]. Comic plays role as a media in various physics learning [12], [15]. Its applicative use can be utilized as a media to help student in understanding physics theory since the storyline can encourage student to have contextual thinking [16], [17].

The usual comics are packed in a book form. However, along with the times comics are also provided in electronic form which is known as mobile comic. Physics comic which is developed in mobile application form allow convenience to be carried anywhere. Android is one of mobile operating systems grows in the middle of other operating systems that are developing at this time [18]. Learning media can be developed through this android system which is growing rapidly nowadays [19]. Android-based physics comic acts as a media for learning physics. The comic contains optical devices about eye and camera for senior high school. This comic is developed and tested for feasibility before being used in a big scope.

2. Research method

The method of research used in this research is research and development/R&D. This method was used for developing or validating the product used in inquiry and learning. The model used in this research and development is ADDIE. This model consists of five steps; (1) Analysis, (2) Design, (3) Development, (4) Implementation, and (5) Evaluation [11].

The stages of research based on this model are (1) *Analysis*, aims to analyze the needs in learning. (2) *Design*, start to design product that will be developed according to the results of the needs in learning analysis. (3) *Development*, is the process of creating and developing product according to design. (4) *Implementation*, is the stage to use the developed product. (5) *Evaluation*, improving product based on criticism and suggestions from the questionnaire responses done by respondents after using the developed product. This model has a structure arranged systematically as illustrated on the figure 1.

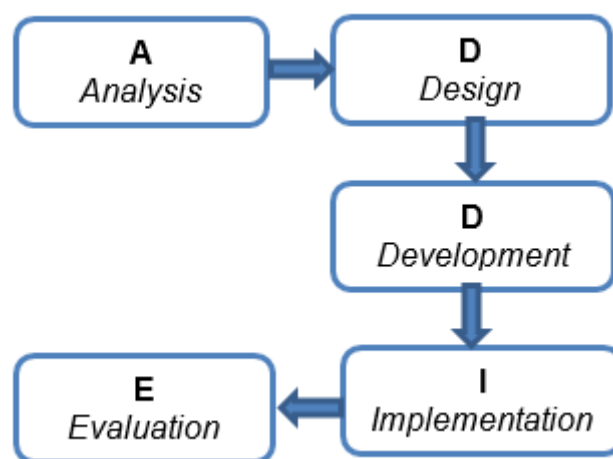


Figure 1. The model stages of ADDIE.

This research was conducted on the second grade high school students of science program. The learning was done in groups by reading the comics first and then discussing. The use of this android-based physics comic is expected to help students understand the optical devices about eye and camera. The research and development of android-based physics comic obtain validation data and suggestions for improvement from material and media experts. Furthermore, improvements of product were made on revision I. The result of product improvement on revision I was developed and used by respondents in school. The responses of respondents were obtained through the questionnaire responses after using

the product. The result of the questionnaire responses was used to hold evaluation and advanced improvement on revision II. These research and development were done in March 2019 to April 2019.

The method of collecting the data uses expert validation sheet and questionnaire responses of respondents who are students. The validation sheet was used to obtain expert judgement. The questionnaire responses sheet was used to obtain assessment from the respondents. This collecting data method was used to obtain data about the use of android-based physics comic on eye and camera.

The analysis of the instruments of expert validation sheet and questionnaire responses is used to test the developed product feasibility. The score result from each instrument is stated in [2],

$$P = \frac{f}{N} \times 100\% \quad (1)$$

f is the frequency sought for the percentage, N is number of cases (overall data), and P is percentage number. Product feasibility criteria can be seen in table 1.

Table 1. Product Feasibility Criteria

Questionnaire Score	Category
80.01 % < score ≤ 100%	very good
60.01 % < score ≤ 80.00%	good
40.01 % < score ≤ 60.00%	reasonable
00.00 % < score ≤ 40.00%	poor

3. Results and Discussion

Based on the analysis, there is problem in learning physics such as the media of learning is lack of variation and the delivery of material is less contextual [5], [19]. This result was gained through the observation and interview in SMA Negeri 1 Kalasan. The interview was conducted on teachers and students.

Based on the design stage, there is a medium plan to solve the problem in learning physics. The media android-based physics comic on eye and camera for second grade high school students is expected can overcome the problem. The first stage of creating the comic is making the draft of storyline that can stimulate students to think critically. Then the comic drawing stage started by sketching on the paper. After drawing comic manually on the paper, the next stage is coloring and filling text dialogue by using the corel draw 2017 application. The complete pictures with extension .jpg are arranged into comics by the help of Sigil application [20]. The comic files with extension .EPUB can be opened on android smartphone, where in android smartphone there is already Reasily EPUB or EPUB Reader application.

Android-based physics comic is designed for android operating system with minimum specifications such as: (1) the file size less than 250 MB, (2) minimum 512 MB RAM, (3) minimum android version of ICS (Ice Cream Sandwich), and (4) a minimum of 240x320 pixel screen. The storyline packed in Indonesian comic tells the friendship of Chiko and Nino. They accidentally meet in the park near their houses. Then, they share information about Nino's new optical devices book and Chiko's camera gift bought by his father. Based on their discussion in the park, there is some knowledge about optical devices especially the eye and camera which can be learned by comic readers. The full color image and clear font are expected to attract the readers. Figure 2 shows the display of the comic in android-based smartphone.

Android-based physics comics that have been completed are then validated by experts to get improvements. The product improvement results are then developed to be tested on students (development). The implementation stage is done by implementing the product in learning physics at school. The goal is to find out the students' responses to the developed media. The students' responses to the use of developed product can be seen from questionnaire responses as an evaluation material (evaluation). The validation result of android-based physics comic learning media on eye and camera obtained from expert and respondent assessments. The more complete explanation is explained as follows:



Figure 2. Android-based physics comic on eye and camera.

3.1. The validation of android-based physics comic on eye and camera by material experts

The result of research and development in the form of android-based physics comic on eye and camera is validated through the expert assessments. The assessment by material experts covers three aspects of the assessment namely; (1) content feasibility, (2) presentation, and (3) linguistic. Each aspect has its own assessment indicators. The result of validation of each component is expressed as a percentage. The result of validation done by the material expert is presented in the table 2.

Table 2. The validation result of android-based physics comic on eye and camera by material experts.

Aspect	%	Category
Content Feasibility	78.57	Good
Presentation Feasibility	75	Good
Linguistic Feasibility	100	Very Good

The result of validation shows that each aspect (content feasibility, presentation, and linguistic) get a “very good” average category. This result of validation shows that android-based physics comic on eye and camera is feasible to use in learning. These results are supported by study [9], [15].

3.2. The validation of android-based physics comic on eye and camera by media experts

The result of research and development in the form of android-based physics comic on eye and camera is validated through expert assessments. The assessment by media experts covers six aspects of assessment namely; (1) quality of content, (2) linguistic, (3) implementation, (4) visual display, (5) picture, and (6) ease of use. Each aspect has its own assessment indicators. The result of validation by media experts is presented in the table 3.

The result of validation shows that each aspect (quality of content, linguistic, implementation, visual display, picture, and ease of use) get a “very good” average category. This result of validation shows that android-based physics comic on eye and camera is feasible to use in learning, as in [6], [7].

Table 3. The validation result of android-based physics comic on eye and camera by media experts.

Aspect	%	Category
Quality of Content	100	Very good
Linguistic	100	Very good
Implementation	100	Very good
Visual Display	66.67	Good
Picture	50	Reasonable
Ease of Use	100	Very good

3.3. The students' responses to android-based physics comic on eye and camera

The result of research and development in the form of android-based physics comic on eye and camera is tested on students. The goal is to find out students' responses to the developed media. The students' responses are given through three aspects of assessment, namely; (1) interest, (2) theory, and (3) language. Each aspect has its own assessment indicators. The result of assessment of each aspect is expressed as a percentage. The result of assessment by respondents is presented in the table 4.

Table 4. The students' responses to android-based physics comic on eye and camera.

Aspect	%	Category
Interest	91.67	Very good
Theory	88.89	Very good
Language	99.30	Very good

The students' responses show that the three aspects of assessment (interest, theory, and language) get an average percentage in the "very good" category. This result is supported by the research [7], [9], [15] which states that the respondents give very good responses to the developed media. The result of responses indicates that the developed media is feasible to use in learning.

The result of product development indicates the form of physics comic is able to overcome the physics learning problem. The physics learning becomes more contextual, interesting, and diverse [6], [14]. Learning physics by using comic can also improve literacy and thinking ability of students [8], [12].

4. Conclusion

The result of research and development is the product of android-based physics comic learning media on optical devices about eye and camera. The assessment of android-based physics comic by media experts and material experts shows the high score of feasibility with a very good predicate. The assessment was done by respondents also shows the high score of feasibility with a very good predicate after experiencing the comic. Therefore, it is concluded that android-based physics comic is feasible to use in physics learning.

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