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Developing Learning Media of Physics Using MIT App Inventor to Improve the Critical Thinking Skills

Nur Khoiri^{a)}, Diana Arin Wahyuningsih, and Duwi Nuvitalia

Universitas PGRI Semarang, Semarang, Indonesia

^{a)} Corresponding author: nurkhoiri@upgris.ac.id

Abstract. The research was carried out using the Research and Development method which includes define, design, develop, and dissemination. The data was collected using a questionnaire, the observation sheets and the tests. The results showed that the product development media is valid, feasible and effective in improving students' critical thinking skills. The percentage of validity score is 77% and the percentage score is 78%. The results of statistical analysis show that the developed learning media can improve students' critical thinking skills, particularly in the designing part which facilitate students both analyzing and discussing in a comprehensive way.

INTRODUCTION

The development of technology have had an impact on changes in various dimensions of human life, such as economic, social, cultural and educational. These changes result in a movement towards a balance of the new life order [1]. The challenge of a new life which is known as the 21st century requires the new types of skill. As a result of the demands for change also have an impact on learning orientation which has shifted as a result of changes in the new life order [2]. The skills needs of the current generation include critical thinking skills. Critical thinking skills are strongly suspected to be very important skills needed by the current generation [3]. One of those affected by this condition are the Teacher Trainer Institution (TTI) graduates or prospective teachers, since they teach the new generation in different ways from the knowledge provided to prospective teachers when they studied at TTI [4].

One of the challenges that require continuous innovation for prospective teachers is related to the learning media that will be used in the learning process [5]. Learning media is the tools that can be used to deliver the messages from the learning materials which are expected to stimulate attention and interest. Android-based learning media becomes one of the media in learning science that can be concreted by utilizing technological developments in the field of education. Android is a very complete platform in which of its operating system, applications and development tools. It has extremely high support from the open source community in the world; therefore, android continues to grow rapidly in terms of technology and the number of devices in the world [6]. Moreover, android is currently used by almost all school-age children, especially since the Covid-19 pandemic era. The use of Android has been accelerated as a means of online school. Therefore, it is a significant need to optimize the use of learning media through mobile learning by equipping the students with the particular skills which prepare them facing the education in 21st century [7].

According to the TIMSS (Trends in International Mathematics and Science Study) 2015, the average percentage of Indonesian students' reasoning abilities was 26%, while the international average was 44%. According to Bloom's taxonomy, reasoning abilities are included in higher order thinking skills [8]. Critical thinking skills becomes a part of higher order thinking skills that important to acquire. However, regarding to the condition of the low critical thinking skills of students, it becomes a challenge and anxiety for educators in Indonesia to improve students' critical thinking skills as future generations. Therefore, it is important to do a research in developing learning media of physic which enable the teachers to create a conducive classroom so that increase the students' critical thinking skill.

13

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METHODS

This study involves the Research & Development model, which is a process carried out to develop and validate the educational products [9]. The data collection techniques are questionnaires and tests. The development research consists of four stages, namely define, design, develop and disseminate [10]. Define is a preliminary activity that aims to collect all the information needed through field studies and literature to compile the initial product. There are two activities in this stage namely a literature study which consist of material analysis and media making devices, and the second activity is that the use of media that was developed. The material that delivered in the media should appropriate to the standard competence (SK) and basic competence (KD). The assessment process which includes SK/KD analysis, learning resources, material selection and user determination is carried out simultaneously because it is interrelated and cannot stand alone. At this stage, data collection is also carried out that is closely related to the material, media making devices and the use of media. *Design* is the activity of making detailed specifications of the media to be made. A good and well-planned design will make it easier to create further media. The media design was firstly designed in the form of a script then developed which consists of objects that will be used in making learning media such as text, images and sound using the MIT App Inventor software. *Develop* is an activity to develop a product in the form of an Android application that contains materials, exercises and evaluations related to learning materials and critical thinking skills such that resulting a product that is ready to be validated. At this stage, the validation of the learning media used the MIT App Inventor. This validation consists of material, media and user. *Dissemination* is an activity to disseminate products to students.

RESULTS AND DISCUSSION

The research begin with a preliminary study which consist of activity such as problem identification activities by conducting literature studies and analyzing pre-existing learning media. Pre-existing media emphasizes the aspects of student interest in using learning media. Meanwhile, the development in this study is that adding the aspects of critical thinking skills to the learning media that will be developed. It is necessary to collect data by conducting an assessment of the material and an assessment of the media making device to overcome the problems found in the previous stage. In making learning media used hardware and software.

The product developed is a learning media with an App inverter oriented to critical thinking skills. The development of learning media is expected to facilitate educators and students in conducting learning interactions. Students are expected to be able to study independently anywhere and anytime so that they can improve their critical thinking skills. The main characteristic of the learning media developed consists of a cover page, which is the page that first appears when the user opens the application on a smartphone, and the menu page is the core page of the learning media. Therefore, it will be expected that from the cover could attract the user and also can access all the menus presented on the learning media. The menu on the menu page contains chapter 1, chapter 2, chapter 3, chapter 4 and chapter 5 as well as Info. The display of each chapter consists of concept maps, materials, evaluations and videos, to display information containing instructions for use, about the author and a bibliography. The structure and content which has been elaborated are the main characteristics as a differentiator from the existing media.

The development of learning media can be categorized as a quality product if it meets the elements of valid, appropriate and effective can be used in accordance with the objectives of media development. It should meet the content and construct validity. The content validity relates to the relevance or novelty, and the construct validity relates to consistency or program design logic [11]. The developed product is validated before tested by the validators who are experts in their fields to ensure that the developed product can be scientifically justified and the results can be used. It was validated by three validators who have expertise in their fields that is a lecturer of Physics Education who was a material expert, a lecturer of Physics Education who was a media expert and a Physics teacher of who was an expert practitioner. Each expert validation has its own aspect, namely the material expert has assessment aspects such as content feasibility aspects, presentation feasibility aspects, and implementation. Media experts have assessment aspects, namely visual communication aspects and software engineering aspects. Meanwhile, expert practitioners have assessment aspects, namely the content of the material, evaluation of the material, audio-visual communication and software engineering. Physics learning media oriented by critical thinking skills is feasible to use if the validation score of each item percentage of the feasibility in the level criteria of feasible or very feasible. If the assessment item is obtained as a percentage at the level category not feasible or very inappropriate, then the physics learning media oriented to critical thinking skills is said to be invalid or not feasible to use.

The first validator provides notes regarding to the feasibility of the product being developed with the average of percentage of 75% with a feasible category and can be used with revisions. The recommendations and suggestions from the first validator expert is that need the improvements of teaching materials in the writing of concept map section. Therefore, the next step is to improve the writing on the concept map section. The second validator gives a percentage score of the feasibility of the developed media is 77% with a very good category and can be used with revisions. A note from the validator is that it needs improvements to the image size in the application software. Therefore, the next step taken by researchers is to improve the size of the image in the application software. The third validator provides an assessment with a percentage score of 78% with a very feasible category and can be used with revisions. The suggestion from the third validator is to insert several pictures in the text. The average validation score of each validators is shown at figure 1. Overall, the product changed at the appearance of the media become simpler but aesthetic with keep the aspect supporting students' understanding.

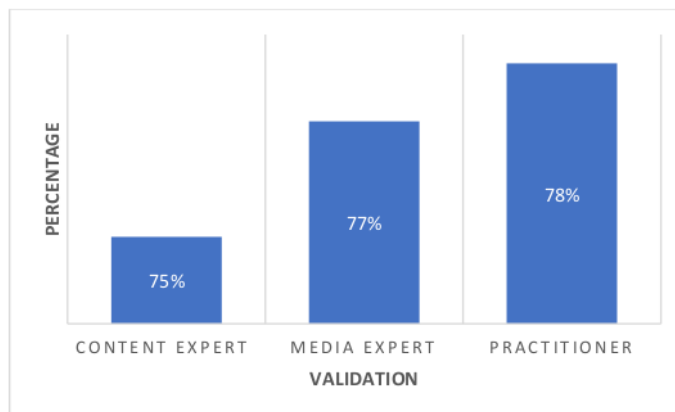


FIGURE 1 The average of validation score the developed learning media

Based on the data that has been presented, the results of the validation of learning media by the three validators get an average percentage score of 76.7, %. The percentage score is included in the valid category. This shows that the developed learning media products oriented by critical thinking skills that meet the requirements to be used for further testing with students. Moreover, the revise version of the prototype is more aesthetic, simpler, without reducing the aspect that develop students' understanding. In the designing part, there is an activity that involve the students to analyze the data which comprehensively form the students' critical thinking skill habit through a discussion. Therefore, this media could train and improve the students' critical thinking skills.

Testing product development to students is intended to determine the effectiveness of the impact of the developed media on students' critical thinking skills. In the implementation of the trial process, the data about critical thinking skills were obtained by making observations in learning using android-based media in grade X at even semesters. The observation process was carried out before and after using learning media. The results obtained show that the learning media has increased N-Gain 0.6 in the medium category. The results of statistical analysis of pre-test scores and post-test scores in the class showed that the pre-test scores did not increase. However, the results show that after using learning media there is a significant difference. It can be strongly suspected that the learning media has an impact on improving students' critical thinking skills. The results of the study have strengthened the research that has been done by Syawaludin, et al.[12] stating that the effectiveness of using learning media can improve students' critical thinking skills. The use of interactive android-based learning media affects students' critical thinking skills, making it easier for students to formulate problems, analyze, dig up information, evaluate information and find solutions. Meanwhile, the results of the critical thinking skills test in the pre-test and post-test stages are presented in figure 2.

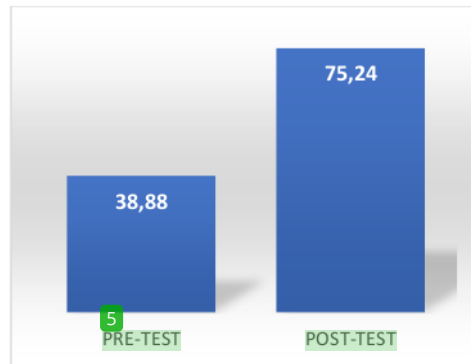


FIGURE 2 The results of pre-test and post-test

In the implementation stage, the average pre-test score was 38.88 and the post-test score showed an average of 75.24, obtaining a gain criterion of 0.6 with moderate criteria. Based on the data above, it illustrates that the developed learning media have an impact on students' critical thinking skills. The impact of changes in critical thinking skills on students is caused by the use of developed learning media, the developed media creates the situations and learning stages that stimulate better of students' critical thinking skills. In detail the post-test results based on critical thinking skills indicators as presented in table 1.

TABLE 1. The scores of each critical thinking skill indicators

No	Critical thinking skill indicators	Average score
1.	Providing a simple explanation	8.3
2.	Identifying the assumption	6.7
3.	Concluding	7.1
4.	Analyzing	6.6
5.	Evaluating	7

Based on the table 1, the indicators for analyzing obtain the lowest average score, meaning that students' ability to carry out analysis still requires assistance and further research can be carried out. Meanwhile, the average value of the indicator that obtain the highest score is the first indicator that is providing a simple explanation. The students are able to understand well and are able to give a brief explanation of the information presented by the media. It means that the media developed is very communicative and easy to understand. On average, it can be concluded that the application of android media has improved students' critical thinking skills.

The use of thinking stages in the evaluation is a step in training students' critical thinking skills. The results are in line with the results of the study that thinking skills need guided practice because students rarely transfer these thinking skills themselves. In order the items written can require high-level thinking, then each item should be given a basic question (stimulus) in the form of a source/reading material [13, 14]. The study also stated that the use of android applications was effective in increasing interest, student learning outcomes in physics material, and critical thinking skills [15 -17].

CONCLUSION

Based on the results the discussion, it can be concluded that the developed physics learning media is valid, feasible and effective to improve students' critical thinking skills. Therefore, the media facilitates the students with the opportunity in data analyzing which trains and improve the students' critical thinking skill through discussion.

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