The Development of Android-Based Physical Learning Media Brain Quiz Game Assisted on Momentum and Impulse Materials

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Abstract. This research was conducted because of the limited number of Android-based physics learning media. The purpose of this study was to develop a physics learning media in the form of an Android application on momentum and impulses material. This research is development research by adopting the ADDIE development model. At the analysis stage, problem analysis and needs analysis were carried out. At the design stage, when the initial design began to be made, the next step was material and media experts validation. In the implementation phase, learning media design was tested on a small scale test with a total of 8 respondents and a large scale test with a total of 96 respondents from 3 schools in the city of Tangerang. The evaluation phase was done by analyzing expert validation data, small-scale tests, and large-scale tests. Data obtained through the observation method were analyzed descriptively qualitatively. While the validation data were analyzed descriptively qualitatively and quantitatively. The average score of material experts is 90.16 % (very good), media experts 81.30 % (good), small scale tests 80.74 % (good), and large scale tests 81.67 % (good). So, it can be concluded that this application is worthy of being used as a medium for physics learning.

1. Introduction
The development of the globalization era, which has been marked by the rapid use of information technology succeeded in shifting the concept of organizing education concern in a modern way. Modern features in the world of education were marked by the birth of technology innovation-based learning concepts [1]. Technology-based learning innovation is considered as media that has a strong potential in improving the quality of education [2].

The choice of the technology-based learning media has a very important role [3], which is by utilizing technology-based learning, an educator can make effective, fun, and challenging learning environment [4], and can help students in understanding teaching material [5, 6]. Moreover, the selection of learning media must correspond to the competencies that have to be achieved [7] in order to give a positive value in increasing students’ understanding of the teaching material which has been delivered [3, 5].

The use of technology in the world of education continues to grow, one of the examples is e-learning. One part of e-learning is m-learning [8]. M-learning exists as potential media to minimize misunderstandings and accelerate the learning process [9], facilitate learning by supporting
communication between educators and students, enabling flexible learning, increasing the search for information sharing, media discussion, and the use of other features [4, 10 -12]. One of developing devices of m-learning as learning media is a smartphone. Smartphones are equipped with mobile learning features [13] and according to the Ministry of Research and High Education of Indonesia and the number of smartphone users in Indonesia reaches 25% or around 65 million users, with students contributing a percentage of 10% as smartphone users [7].

Therefore, the mobile learning which had developed in this study utilizes a smartphone with the Android operating system. This is based on the popularity of students who use the Android operating system more than (83%) compared to other operating systems. The Android operating system is one of the 21st-century learning applications [14], is an open-source and provides opportunities for users to develop other application features as needed [6, 13, 15-16], and can be easily accessed anywhere and anytime [2, 13-15]. Also, the Android operating system is considered to be an appropriate learning media because almost every student makes it as inseparable object in everyday life [17].

Based on observations' result is obtained data that 29% of smartphone users use it as a medium for sending and receiving messages, 27% for browsing, 23% for playing games, and 21% for learning and adding knowledge. In other facts says that students use smartphones only to spend time in vain [14]. This shows how familiar the smartphone is among students, and certainly becomes a challenge in developing technological concepts related to the concept of education.

These various potentials are then used as opportunities to develop Android-based physics learning medium. The concept of development will try to combine the concept of games and learning material. Both combinations need to be designed properly to suit the needs of students. Also, the concept must be able to provide updates in the field of education by trying to answer complaints about the difficulty of understanding abstract physics material. Therefore, it takes a real visualization through the concept of the game and be able to help students understand in momentum and impulses.

The merger of these concepts becomes very important in the world of education, this is because it will be the main attraction of students learning which ends in increasing learning outcomes and involvement of students in the learning process [18]. The concept of the game chosen is the brain quiz game. This is based on the popularity of students who prefer brain quiz (56%) compared to other forms of the game. Brain quiz games are more chosen because they are very motivating, easier, more relaxed, more exciting, more challenging, not boring, and can attract students’ learning interest.

2. Method
This research is development research by adopting the ADDIE development model (analysis, design, development, implementation, and evaluation). This model was chosen because it is suitable for the goals of researchers in developing Android-based physics learning media assisted with brain quiz games on momentum and impulses.

The developed learning medium is then validated by giving validation instrument sheets to two material expertise and two media expertise by their respective fields. The small scale test was carried out in Bina Dharma High School with a total of eight students, and the large scale test was conducted at MAN 1 Tangerang City, SMAN 5 Tangerang City, and SMA Nusantara 1 Tangerang with a total of 96 respondents.

The validation instrument was arranged with a Likert scale (1-5) The result of the validation instrument then count with the equation follows [19].

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p = \frac{f}{N} \times 100\%
\]

Information:
- \(p\) : Percentage Number
- \(f\) : Frequency of the percentage
- \(N\) : Number of frequency/number of person
The result of validation which has been counted then analysed according to through assessment guidelines [20].

| Mastery Level (%) | Value | Score | Category  |
|-------------------|-------|-------|-----------|
| 86 – 100          | A     | 4     | Very Good |
| 76 – 85           | B     | 3     | Good      |
| 60 – 75           | C     | 2     | Intermediate |
| 55 – 59           | D     | 1     | Bad       |
| ≤ 54              | TL    | 0     | Worst     |

3. Results and Discussion

The product produced in this research is a learning application which is then called the Physics Education Games. This application was developed based on the ADDIE development model, with the analysis phase carried out by analyzed problems, needs, media material, development specifications, and media-making tools. The design phase begins by integrating the concept of the game brain quiz with the concept of momentum and impulses material by the flowchart and storyboard then validated by material and media expertise.

The development phase is carried out by making learning medium that is suitable by the needs of Students by specified media development specifications. This development is carried out by utilizing the Unity application with C# programming language as a learning media development software and Corel Draw X7 application, Blasmiq Mockup, and Adobe Illustrator design development software. The implementation phase is carried out by conducting small-scale and large-scale tests. The evaluation phase is carried out by analyzing the data validation of material and media expertise, as well as the results of the implementation of the media on a small scale and large scale tests.

3.1. Product Validation

Learning media that have been developed are then validated by material and media expertise. The validation process is carried out by presenting a developed draft 1 application, for later being tested and assessed in eligibility by filling out the validation sheet which has been provided. The results of material and media expertise validation are in the form of quantitative data which can be presented by the following figure.

![Figure 1. Assessment of Both Material Expertises](image-url)
The material expertise validation results in Figure 1 shows the average value of validation in content eligibility aspect for 94% (very good), material presentation worthiness aspect for 91% (very good), content language, worthiness aspect for 87.5% (very good), and assessment contextual aspect equals to 89.5% (very good). All aspects of the assessment are in a very good category with an average value of validity of both material expertise is 90.16%. It is because the material compiled by core competencies, basic competencies, and the indicators of achievement competencies that are contained in the syllabus and learning implementation plan.

![Graph showing assessment of material expertise](image)

**Figure 2. Assessment of Both Media Expertises**

The results of the validation of media expertise in Figure 2 shows the average value of validation in the aspects of learning design at 76.66% (good), the aspect of writing eligibility of 76.66% (good), the aspect of display worthiness of 81.66% (good), and aspects of the use of instructional media 86.66% (very good). There are three aspects of assessment in good category and one aspect of assessment in the very good category, with an average value of validity of the two media expertises at 81.30 (good). Aside from obtaining quantitative data assessments, researchers also obtained qualitative data assessments from material and media expertise in the form of comments and suggestions. This qualitative data is then used as a guide in improving the developed learning media.

3.2. Product Implementation

Learning media that have been improved based on comments and suggestions from material and media expertise then carried out in a small-scale and large-scale test. The implementation process is carried out by presenting the application that has been developed, then tested and assessed for eligibility by filling out the validation sheet which have been provided. The following figure are the results of evaluating media implementation in small and large scale tests.
The implementation of learning media in small-scale test was carried out by eight respondents. The results of learning media implementation in a small-scale test are shown in Figure 3 with the average value of validation obtained on the aspect of display worthiness at 81.25 % (good), the average value of material presentation at 79.32 % (good), and the average value of media used learning at 81.66 % (good). All aspects of the assessment are in the good category with an average value of all aspects at 80.74 % (good). Besides, researchers also obtained qualitative data that were used as comments and suggestions in finishing the developed learning media.

Improvements were made by changing the music or back sound to be calmer and can be accepted by all users. Besides, researchers also improved graphic design applications for single ball and multiball games. After that, the learning media was re-implemented on a large scale test with 96 respondents. The results of learning media implementation on a large scale test are shown in Figure 4 with an average value of validation obtained on the aspect of display eligibility at 81 % (good), the average value of material presented at 80 % (good), and the average value of media utilization learning at 84 % (good). All aspects of the assessment are in the good category with an average value of all aspects of 81.67 % (good).
Besides obtaining quantitative data, researchers also obtained qualitative data that were used as guidelines of making improvements. Improvements were made by clarifying the game guidelines on the type of single and multiball. Researchers also make improvements due to problem’s duration which is too fast or too slow in displaying teaching material. These improvements were made to produce a final draft of the learning medium which could then be implemented widely.

3.3. Final Product Review
The Physics Education Games application is physics learning medium that collaborate brain quiz games with momentum and impulse. This application consists of single and multiball games which consists of 20 game levels each. Each type contains teaching materials, multiple choice quizzes, quiz questions, and brain quiz games. This application was developed, analyzed, and improved based on comments and suggestions at the validation and implementation stages. Overall the media developed is suitable for use, can be obtained through the Google Play Store application and existed on the Android smartphone.

![Figure 5. Screenview Page](image1)

![Figure 6. Screenplay Choices](image2)

![Figure 7. Application Guideline](image3)

![Figure 8. Game Page](image4)

![Figure 9. Quiz Page](image5)

![Figure 10. Quizes Answer Key](image6)

3.4. Discussion
The results of research that researchers do then compared with the results of previous studies. Based on research conducted by Vina Serevina, et al. [2], S Agustihana and Suparno [3], and S Sari, et al. [4], the
results are obtained that all three studies are categorized as very good and feasible to be used in the learning process. The results of the study did not differ greatly from the results that researchers obtained, with categories suitable for use in the learning process with an average rating of 90.16 % material expert (very good), 81.30 % media expert (good), small scale test 80.74 % (good) and large scale test 81.67 % (good).

The Physics Education Games application is an innovative learning media that is able to adapt to technological development. This application can be used offline on all Android smartphone resolutions and can be freely obtained by downloading through the Google Play Store application. It has a size of 28 MB and can be used anywhere and anytime without being connected to the internet network. The appearance of an interesting and attractive game can increase the interest and curiosity of students in learning, improve students’ ability to discuss, and motivate students to continue to use it.

Collaboration on momentum and impulse with brain quiz games in technology-based learning applications (Android) were expected to be able to support and improve the quality of learning. This learning media facilitates students to think critically in completing each stage of the game [21, 22] and in answering quiz questions presented. Through this application, the learning process becomes more challenging and fun. Students become easier to learn and understand the material. Students can play and learn by continuing to improve the ability to think creatively and systematically and practice dexterity in playing.

4. Conclusion

Developing Physics Education Games applications utilize Android-based smartphones as storage and learning media. The concept of the brain quiz game has collaborated with the concept of momentum and impulse material. Utilization of this application can be used as a medium in the learning processes, with the availability of teaching material concepts, brain quiz games, question exercises, and discussion of questions. This application has been launched on Google PlayStore and can be downloaded with the keyword “Physics Education Games”. This application is considered feasible in both categories based on validation conducted by material and media expertise, and based on implementation on a small scale and large scale tests. So it can be concluded that the application of Physics Education Games is appropriate to be used as a medium of learning physics in supporting material momentum and impulses.

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