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Edu-game Application Based-Android Quantity and Unit Concepts Using Game Engine Constructs 2

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Abstract: The purpose of this research is to produce alternative learning media about understanding the concept of unit size as an interactive and fun educational tool. This research uses the Research and Development (R&D) method and the product development model uses the MDLC (Multimedia Development Life Circle)) consisting of six stages, namely concept, design, material collecting, assembly, testing, distribution. The media expert validation test concluded that media expert 1 with an average percentage of 77% included the criteria of "Appropriate", media expert 2 with an average percentage of 80% included the criteria of "Very Eligible", and media expert 3 with an average percentage of 97% included criteria of "Very Eligible". The overall results of the validation of media experts obtained an average percentage of 84% including the "Very Eligible" criteria. Limited trials with 32 respondents resulted in an overall testing average of 97% including the criteria of "Very Eligible" and for achieving student learning outcomes an average of 84.34 was obtained including the criteria above the KKM. The results of this study are the Edugame Application of the Android-Based Concept of Units and Quantities Using Game Engine Construct 2 which is suitable for use.

Keywords: Application Based-Android; Edu-game; Game Engine Constructs 2; Quantity and Unit Concepts

Introduction

Education makes a significant contribution to the progress of the nation and character building (Blumberg et al., 2019; Rahmatullah et al., 2022), so that education cannot be separated from people's lives. Education is one of the efforts to produce high-quality human resources. The rapid development of the times has resulted in quite significant changes in the world of education, changing the mindset of educators from an ordinary and rigid mindset to a more modern mindset (Limeri et al., 2020). Efforts to improve the quality of human resources must go hand in hand with efforts to improve the quality of education (Nurulita, 2021). Improving the quality of education is the responsibility of everyone involved in the learning process, especially teachers. Interaction between teachers and students will occur during the learning process.

Physics is a branch of Natural Sciences which does not only include knowledge in the form of facts, concepts or principles (Antonova et al., 2020; Emmeche, 2023), but is also a learning process that provides students with direct experience with the natural environment in order to understand it scientifically. We can learn about natural phenomena in the context of infinite space and time through physics lessons, so that students are expected to be able to construct physics concepts, collate scientific skills, process skills, and critical thinking skills to solve problems in everyday life. However, students still have difficulties with their limited conceptual knowledge and abilities. This problem makes students believe that physics is a difficult subject to understand (Khoiri, 2023; Utiah & Paramata, 2018). One of the junior high school level or equivalent physics learning materials is quantity and unit. According to Sandari (2021) everything that has value and can be expressed numerically is called a

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quantity, and the measurement of the internal comparison of a quantity is called a unit.

The problem that often occurs in the physics learning process at the junior high school level or equivalent is the lack of student interest in participating in the learning process (Nkadimeng & Ankiewicz, 2022). Furthermore, the material contained in physics lessons has concepts that are difficult to understand. Other factors that influence why students are less interested in participating in the learning process include the delivery process and the learning media provided (Jamalulail et al., 2022; Rahmawati et al., 2021; Sabtu et al., 2019).

Likewise with the media supporting the learning process at SMP Negeri 15 Semarang which still uses the discussion and question and answer method and relies on printed books and the internet to support the learning process received by students. Sometimes students feel less enthusiastic about participating in the Measurements and Units learning process because they have to memorize the quantities and units. In addition, nowadays students are allowed to bring smartphones to school. The use of smartphones in the learning process is not maximized so that students feel bored with the Magnitude and Unit subjects so that a proper supporting media is needed for the learning process.

One of the things that can be done to improve and update the learning system while helping students understand learning is the use of appropriate educational game-based learning media (Alam, 2022; Anastasiadis et al., 2018; Mohanty et al., 2021). Educational games are created and specifically designed to be used as a medium for teaching students through material that contains sound, text, images and animations whose main material discusses certain objects with the aim of broadening concepts and providing a deeper understanding (Kao et al., 2017). Besides being used as an alternative media, this educational game is also equipped with quizzes that can help students to find out their abilities and can be used at home to facilitate students' independent learning.

Based on the description above, it is necessary to create a learning media in the form of an educational game that is appropriate for use to increase understanding of the concept of Natural Sciences, especially in the Physics subject of Quantities and Units in order to facilitate student learning by utilizing the concept of learning while playing with the title "Applications of Edugame Concepts of Magnitude and Android Based Unit Using Game Engine Construct 2".

Method

In this study using Research and Development (R&D) research and development methods because this research has the aim of developing interactive learning media (Hutahaean et al., 2022; Syawaluddin et al., 2020). Research and Development is a series of processes or steps that must be followed to develop new products or improve existing products. Products are not always objects or hardware, such as books, modules, or learning aids in the classroom or in the laboratory, but can also be in the form of software, such as computer programs for processing learning data in classrooms, libraries, laboratories, educational models, learning, training, guidance, evaluation, management systems, and so on. This research method is considered quite effective for improving practice (Arsyam & Tahir, 2021). To obtain product results, developers use needs analysis research to test product effectiveness, therefore developers use the MDLC (Multimedia Development Life Circle) model. There are six stages of the process, namely concept, design, material collecting, assembly, testing, and distribution (Nurdiana & Suryadi, 2017).

Concept

The concept stage establishes the program goals and who will use them. The nuances of multimedia are influenced by the goals and objectives of the program as a reflection of the identity of the organization that wants information to reach users. User capabilities, for example, must be considered as they can influence design decisions.

Design

The design phase includes the creation of program architecture, style, appearance, and material or material requirements. The design process that occurs at this stage is the design of flowcharts, storyboards, use case diagrams, and activity diagrams.

Material Collecting

The material collecting stage is the stage where materials are collected based on application needs. Images, audio, animation and other materials are required and can be obtained free of charge or by ordering from third parties.

Assembly

The assembly stage is the process of assembling all the material objects that have been collected into an application. Making applications based on design stages such as flowcharts, storyboards, use case diagrams, and activity diagrams that have been made.

Testing

After completing the assembly phase and running the application to see if there are any errors, the testing phase begins. This is also known as the alpha testing stage, and this is where developers test their

applications. This alpha test determines whether app features such as buttons and views work as expected or not. Expert validation is used to carry out assessments which include interface aspects, content feasibility aspects, and application feasibility aspects. If there are errors in the application will be revised.

Distributions

The distribution stage is when the application is saved to the storage media. If the storage media is not enough to accommodate the application, it will be compressed on the application. The following is an overview of the applications that developers make in outline:

Product Design

The software used in making this application is as follows CorelDRAW X5; Construct 2 r280; NWJS for Construct 2; and Android SDK.

Hardware requirements

The hardware used in making this application is as follows laptop windows 10, Processor Intel(R) Celeron (R) CPU N3060 1.60 GHz, Memory 4.00 GB 64-bit; and android smartphones.

System Design

Designing Use Case Diagrams

According to the terms, a use case diagram is an activity or interrelated interaction between actors and systems.

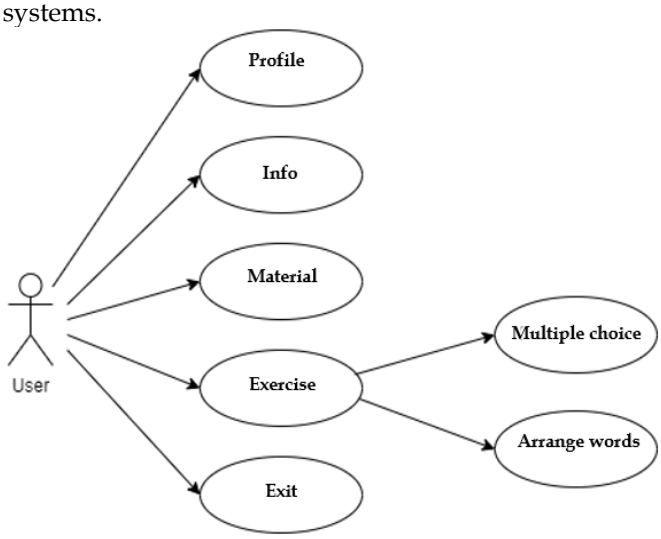

Figure 1. Use Case Diagram

Result and Discussion

The resulting product is the Android-Based Unit and Quantity Concept Edugame Application Using Game Engine Construct 2. The educational game design is as follows:

Display Main Menu

The Main Menu display has six buttons, namely the sound button to activate and deactivate the background music, the profile button to display the developer's profile, the info button to display application information and user instructions, the material button to display Quantity and Unit material, the exercise button to display practice questions and game, and the exit button to display the exit page from the application.

Figure 2. Main Menu Display

Display Menu Profile

The Profile Menu display has one back button to return to the main page. This view appears when the user selects the Profile Menu in the Main Menu.

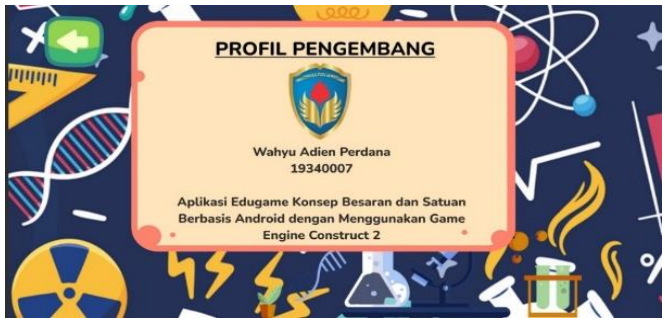

Figure 3. Display of the Profile Menu

Display Menu Info

The Info Menu display has a back button to return to the Main Menu and a next button to display the next slide. This view appears when the user selects the Info Menu in the Main Menu.

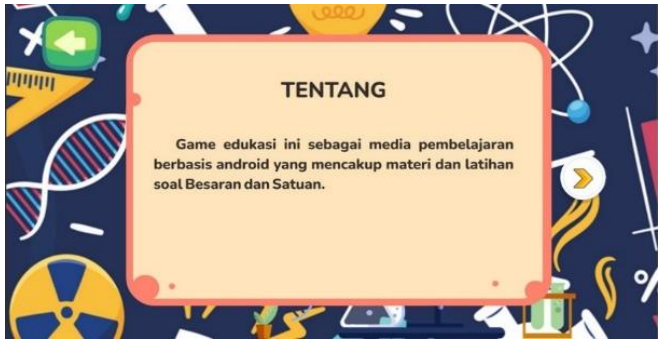

Figure 4. Info Menu Display

Display Material Menu

The Material Menu display has three buttons, namely the back button, the previous button, and the next button. The back button returns to the main menu, the previous button displays the previous material, and the next button displays the next material. This view appears when the user selects the Material Menu in the Main Menu.

Figure 5. Material Menu Display

Display the Exercise Menu

The Exercise Menu display has three buttons, namely the back button, the Multiple Choice Menu button, and the Word Arrange Menu button. The back button returns to the Main Menu, the Multiple Choice Menu button displays the practice questions on Quantity and Units, and the Word Arrange Menu button to match SI unit symbols using the drag and drop method. This view appears when the user selects the Training Menu in the Main Menu.

Figure 6. Display of the Exercise Menu

Display Multiple Choice Menu

The Multiple Choice Menu displays a question and three answer options. There are four buttons, namely, back button, option A button, option B button, option C button and there is a duration of time to work on the questions. Button back to return to the Main Menu, button options A, B, C to choose the right answer. Button option A, B, C to choose the right answer.

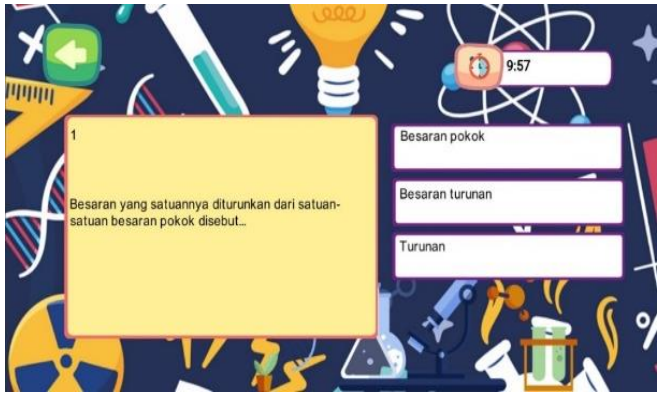

Figure 7. Display of the Multiple Choice Menu

Correct Answer Display in Multiple Choice

Correct answer display in Multiple Choice if the user answered correctly and correctly.

Figure 8. Display of Correct Answers

Display of Wrong Answers in Multiple Choices

Figure 9. Wrong answer display

Display of Multiple Choice Quiz Final Results

The display of the final results of the Multiple Choice quiz contains the score results achieved by the user and is equipped with three star indicators. There are two buttons, namely, the home button to return to the Main Menu and the refresh button to start the game again.

Figure 10. Display of Multiple Choice Quiz Final Results

Display the word order menu

The word order menu display contains matching SI unit symbols using the drag and drop method. There is one button, namely, the back button.

Figure 11. Display of the Word Arrange Menu

Display of Correct Answers in Word Arrangement

Display of the correct answer in Word Arrange if the user answers correctly and correctly.

Figure 12. Display of correct answers in word order

Display of Wrong Answers in Word Arrangement

The display of the final results of the Word Arrange quiz contains the score results achieved by the user and is equipped with three star indicators. There are two buttons, namely, the home button to return to the Main Menu and the refresh button to start the game again.

Figure 13. Display of wrong answers in word order

Incorrect answer display in Word Arrange if the user chooses the wrong answer.

Display the Final Results of the Word Arrangement Quiz

Figure 14. Display of Words Quiz Final Results

Discussion

In this study using Research and Development (R&D) research and development methods because this research has the aim of developing interactive learning media. To obtain product results, developers use the MDLC (Multimedia Development Life Circle) model which consists of six stages, namely concept, design, material collecting, assembly, testing, and distribution.

The first stage, namely the concept (concept) developers conducted observations at SMP Negeri 15 Semarang and unstructured interviews with the school's Natural Sciences teacher (Risnani & Adita, 2018). Based on observations and unstructured interviews, the developer found a problem, namely the lack of supporting media for the learning process and the lack of student interest in the learning process. Magnitudes and Units. Therefore the developer determines the needs analysis, namely the need for alternative and fun learning media for student learning.

The second stage, namely design, includes the creation of program architecture, style, appearance, and material requirements or process materials that occur at this stage, namely the design of flowcharts, storyboards,

use case diagrams, and activity diagrams (Aslan, 2016; Edwards et al., 2015).

The third stage, namely material collecting, the developer collects Magnitude and Unit learning materials, various illustrative images to support educational games, and downloads audio in .mp3 format for free on the internet.

The fourth stage is assembly (manufacturing) the process of assembling all material objects that have been collected such as images, audio, and learning materials into an application. In the process of making an application required hardware and software support. Software requirements include CorelDRAW X5, Construct 2 r280, NWJS for Construct 2, Android SDK and hardware requirements include Windows 10 Laptop Memory 4.00 GB 64-bit and an Android smartphone. Making this application is based on design stages such as flowcharts, storyboards, use case diagrams, and activity diagrams that have been made (Latsyshyn et al., 2020).

The fifth stage is testing (testing) this testing stage is carried out by validating media experts and respondents. The validation test was carried out by three media expert validators, namely Fajar Setiawan, S.Pd. as PTI Study Program Laboratory Assistant, Ika Menarianti, M.Kom. as Head of Digital Business Study Program, and Tri Naluri, S.Pd. as a Science Teacher at SMP Negeri 15 Semarang. Assessment by the validation of media experts obtained the following average percentage results:

Table 1. Average Percentage of Media Experts

Media Expert	Rating result (%)	Criteria
I	77	Very Worthy
II	80	Very Worthy
III	97	Very Worthy
Average	84	Very Worthy

Based on the results of media expert validation, it can be concluded that media expert 1 with an average percentage of 77% includes the criteria of "Very Eligible", media expert 2 with an average percentage of 80% includes the criteria of "Very Eligible", and media expert 3 with an average percentage 97% included the criteria of "Very Eligible". Then for the results of the overall validation of media experts it can be concluded that an average percentage of 84% is included in the "Very Eligible" criteria for use.

After the validation test was carried out by media expert validation, then the limited trial was carried out by class VII I students of SMP Negeri 15 Semarang as many as 32 student respondents. This limited trial resulted in an overall testing average of 97% including the “Very Eligible” criteria. Based on the final feasibility assessment conducted by media experts and students, the average percentage results are as follows:

Table 2. Average Percentage of Eligibility Results

Verifier	Evaluation Score (%)	Criteria
Media expert	84	Very Worthy
Student	97	Very Worthy
Average	91	Very Worthy

Based on the results of the average percentage of eligibility, it can be concluded that the results of the media expert's assessment with an average percentage of 84% included the "Very Eligible" criteria and the results of student assessments with an average percentage of 97% included the "Very Eligible" criteria. Then for the overall results the average percentage of eligibility was obtained 91% including the "Very Eligible" criteria for use. For the achievement of student learning outcomes as a whole, an average of 84.34 was obtained, including the criteria above the standard minimum value.

The sixth stage is distribution. At this stage, the application is stored in .apk format, then this educational game application will be distributed to teachers and students of SMP 15 Semarang as a supporting medium for the learning process of quantities and units. Based on the research conducted, it can be concluded that this educational game application is valid and very feasible to use. Thus the Edugame Application of the Android-Based Concept of Quantity and Unit Using Game Engine Construct 2 can be applied and used as an alternative learning media to support the student learning process in the subject of Quantity and Unit.

Conclusion

Developers can produce educational game applications as supporting media for the learning process of Measurements and Units at the junior high school level or equivalent. In the media expert validation test, it can be concluded that media expert 1 with an average percentage of 77% includes the "Decent" criteria, media expert 2 with an average percentage of 80% includes the "Very Eligible" criteria, and media expert 3 with an average percentage of 97 % includes the criteria of “Very Eligible”. Then for the results of the overall validation of media experts it can be concluded that an average percentage of 84% is included in the "Very Eligible" criteria for use. In a limited trial with 32 class VII I student respondents at SMP Negeri 15 Semarang, the overall test average was 97%, including the "Very Eligible" criteria for use and for the overall test of achievement of student learning outcomes, an average

of 84.34 was obtained, including the criteria standard minimum value.

Author Contributions

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Conflicts of Interest

The authors declare no conflict of interest.

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