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EDUCATIONAL GAME APPLICATION FOR LEARNING INTEGER OPERATION MATERIALS FOR ELEMENTARY SCHOOL STUDENTS BASED ON ANDROID

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Abstract

Currently, elementary school students' enthusiasm for understanding integer material has diminished, as the teaching methods need to be more engaging and enjoyable. With this innovative breakthrough, it will facilitate teachers and students in understanding how the technical aspects of the teaching and learning process can be more effective and efficient. This innovation aims to make it easier for students to review and comprehend integer material anytime and anywhere. An educational game application for learning integer material will be developed, which can be installed on students' Android-based phones or smartphones. This way, students can easily access explanations of integer material. The school is actively embracing innovation in its teaching and learning processes. One of the innovations that will be implemented at Elementary School or students at State Elementary School 1 Yogyakarta Pringsewu is the introduction of an educational game application. This application will assist both teachers and students in quickly grasping the concepts of integer material.

INTRODUCTION

The progress of a nation can be seen through the education process and the outcomes of that education. If the younger generation and learners from primary school to higher education in that nation possess good quality, the progress in the field of education will be recognized by everyone, creating a nation with commendable qualities. After undergoing a good education process, it shapes academic characters that can contribute to further improving the nation. The nation's aspiration is to provide education to every citizen that is proper and of high quality, fostering independence and perfecting the progress of each individual's thoughts, which cannot be underestimated by other countries, making it ready to compete on a broader global scale (Indonesian Law No. 20 of 2003). Education is a process of character creation with professionalism and competence in various fields, endowing individuals with good competitiveness and specific skills that add value to each of its citizens. Therefore, education is one of the most crucial factors for the progress of every individual, impacting the advancement of the

nation. If the learning process from primary school is unpleasant or uninteresting, it is certain that the teaching and learning process will become saturated and challenging to understand. With innovations adapting to current facility conditions, it will facilitate educators and learners in producing high-quality outcomes.

School is a place where teachers and students come together to interact effectively, providing proper education to shape students into brilliant generations. By delivering materials that can mold academic characteristics, schools contribute to the formation of outstanding individuals. Schools also adhere to a standardization of curriculum and teaching processes, adjusting the level to the students' abilities. From elementary school to high school and even to higher education, each stage provides a process for students to acquire competencies and skills that add value to each individual. They become ready to face and compete with various obstacles and challenges in the real world, utilizing these skills in either the workforce or entrepreneurial ventures. Schools play a crucial role in nurturing and honing students' abilities, extending beyond the family environment. They teach not only academic subjects but also social skills, employing methods developed by researchers as alternatives to enhance the students' characters. This comprehensive approach ensures that students are well-rounded and better equipped to navigate the complexities of the real world.

The challenges faced by elementary school students in learning integer numbers are multifaceted and require a comprehensive approach. Several studies have highlighted various factors contributing to students' struggles with integer number operations. Mandasari & Rosalina (2021) identified that students face challenges in writing integer addition and drawing on the number line. Dewi et al. (2020) found that students encounter difficulties in using concepts and principles when solving problems related to fraction operations. Furthermore, Restiani et al. (2023) emphasized that low interest and motivation in mathematics significantly contribute to students' learning difficulties. These findings underscore the importance of addressing not only the conceptual challenges but also the motivational aspects of learning integer numbers. In addressing these challenges, Moreover, instructional media and methods play a crucial role in facilitating students' understanding of integer number operations. Waskitoningtyas (2016) demonstrated that utilizing specific media, such as the number line, can help alleviate students' difficulties in learning about time units. Similarly, Tristanti et al. (2021) emphasized the positive impact of using video media in teaching integer addition. These findings underscore the significance of employing diverse instructional media to cater to students' varied learning needs and preferences.

The research object is taken from State Elementary School 1 Yogyakarta Pringsewu, where a case of saturation in the teaching and learning process occurred in the subject of integers after conducting interviews and observations with students and teachers. Therefore, there is a need for a new alternative to assist teachers and students in the learning process, which is the creation of an educational application, an educational game application specifically designed to bring enjoyment, making students feel engaged in learning integers, especially at State Elementary School 1 Yogyakarta Pringsewu (Pradipta, 2017). To strengthen this research, we can refer to a study conducted by M. Heri Sujaini (2016). This study provides an overview of educational games as a new innovation in learning media for children to understand basic mathematics. It truly generates high enthusiasm among

elementary school students in the interaction process between teachers and students, making the learning experience enjoyable. After testing, the educational math game showed a positive effect on the interaction between teachers and students, with a value of 32%. The researcher concludes that this educational math game enhances the quality of the teaching and learning process and provides clear competencies for each student to understand basic mathematics by using this educational math game media.

Based on the explanation of the innovation that has been made by the researcher, it has a design and aim that can provide more enjoyable information to students in understanding mathematical material, especially integer material, which will later have an Android application that can be used anytime and anywhere and can be used effectively. repeated by students and teachers to assess and analyze to what extent the teaching and learning process produces a higher quality output.

RESEARCH METHOD

Data collection in this research employs observation, literature review, and interview methods. In the Observation Method, the researcher directly observes the condition of the integer learning system at State Elementary School 1 Yogyakarta Pringsewu. Through the analysis, the researcher identifies what needs to be added and formulates solutions to each identified problem. One solution proposed by the researchers is to introduce an innovative approach to the teaching and learning process by creating an educational game for understanding integer material. This serves as the foundation for students to comprehend basic mathematics and will be continuously developed. Additionally, the Literature Review method involves seeking references on the teaching and learning process at the elementary school level from various sources such as the internet, books, and government-standardized curricula. These references serve as the basis and guide for the researcher to develop a new teaching method, specifically using an educational game application for learning integer material, to be implemented at State Elementary School 1 Yogyakarta Pringsewu. In the Interview Method, the researcher directly asks teachers and students about the current teaching and learning process for integer material. The goal is to assess whether there is a need for a new breakthrough in the learning media for understanding integer material. Direct interviews reveal that interest in integer material has declined due to less engaging and enjoyable learning experiences. Recognizing this, the researcher proposes an innovation in the form of an educational game for learning integer material, which will be implemented at State Elementary School 1 Yogyakarta Pringsewu.

The research model employed by the researcher in the case of integer learning media using educational games aims to enhance interaction between teachers and students, making the learning process more enjoyable. The educational application is developed following an ideal model, encompassing analysis, design, development, production, implementation, and evaluation. This strategy for creating an educational game application is expected to facilitate teachers and students in interacting with integer concepts, making the learning process more enjoyable and effective for all students and teachers. The stages of the ADDIE model are as follows:

1. **Analyze:** In this stage, the researcher reviews the object and examines how its input and output needs can be periodically evaluated to assess the effectiveness of the system.

2. **Design:** To create a more interactive application and address input and output needs, a thorough design is necessary. This includes context diagrams and data flow diagrams (DFD) to help solve interaction problems. Database storage is also designed to ensure proper data retention. The interface design is made as appealing as possible for easy use by teachers and students, and the hardware and network requirements are planned so that the application can be used by anyone.
3. **Development:** In this stage, periodic development will occur as improvements to each educational game are made. The researcher closely observes the conditions and situations of teachers and students during implementation to continuously develop the application according to the needs, assisting the teaching and learning process at State Elementary School 1 Yogyakarta Pringsewu in the subject of integers.
4. **Implementation:** In this stage, the direct results of implementing the educational game for integer material are observed to address issues faced by teachers and students.
5. **Evaluation:** Continuous evaluation is conducted to identify system constraints and weaknesses, allowing for periodic improvements. The goal is to provide the best learning services based on the previous application of the educational game system.

Table 1 Application Design Requirement Specifications

Identification	**Necessity**	**Solution**
Need student	Students really like new things or tend towards games	The media is created in the form of an educational game
	A technology that follows the times and is easy to use (smartphone)	The media is created and installed on an Android OS smartphone
Learning Objective	Students can explain integers	A display is created for the presentation of integers

In this activity, to design an educational educational game application system for operating integers for the Yogyakarta Pringsewu 1 State Elementary School, an evaluation needs to be carried out on the application of the teaching and learning process and what the new style is in the teaching and learning process using this educational game.

RESULTS AND DISCUSSION

This discussion will explain how the application of the ADDIE method, namely analysis, implementation, and evaluation, will unfold. After the development model of the educational application for learning integer material is executed, the provided facilities for the application will be outlined. This includes periodic development to enhance the animation and interactivity of the integer material. The development will provide instructions to the game to execute integer material effectively. The application aims to assist teachers and students in the teaching and learning process. It can be easily installed on Android-based smartphones, allowing maximum utilization for learning integer material at State Elementary School 1 Yogyakarta Pringsewu.

1. **Design**

In the game interface, players directly engage with the game created by the developer. The display features various objects that the player can interact with, including moving car objects, numerical objects, subtraction objects, addition objects, and answers. Below is the design display of the educational game designed as a learning media for integer operation material.

Figure 1 Display of educational games

2. Implementation

Presentation and analysis of data from the small group trial of the development of an Android-based educational game product as a learning media for integer material. The subjects for the small group trial represent fourth-grade students, totaling 8 individuals, and the assessment results were obtained. Based on the analysis, discussion, implementation, and trial of the product, the developer's recommendations for the utilization of the created media, which will be further developed in subsequent research, are as follows. Suggestions for utilizing the product related to educational game media are:

a. This product can be used as a learning media for subsequent lessons, serving as a means for delivering material through the educational game.
b. Teachers can use this product for regular teaching and assessments, as it is designed with facilitated time within the learning game genre.
c. Expand the content regarding integer operations once students have grasped the basics and simplification of various integer values.
d. Enhance features to make them more appealing to students for learning fraction operations.

3. Results and Discussion

In the following discussion, the usage of the Educational Game for Integers will be explained, including:

a. General Rules

To understand positive and negative integers, students can select the desired number, and the car representing the chosen integer will move. For example, if a student selects positive integer one, their car will move from number 0 to the right and stop at number one, as shown in the following picture:

Figure 2 Running Positive Numbers

b. Addition of Positive Integers with Positive Integers

In this educational game application, it only provides learning for positive and negative integers and does not cover multiplication or division as the application does not use fractions with decimals. For example, in the learning of integer addition, students only choose positive numbers to be added, such as 1+2 = 3. The educational game will then run to the number 3, indicating that 1+2 equals 3, as shown in the following picture:

Figure 3 Addition of Positive Integers

c. Addition of Positive Integers with Negative Integers

In this section, positive integers are added to negative integers, resulting in subtraction. For example, 4 + (-3) = 1.

Figure 4 Addition of Positive Integers with Negative Integers

d. Addition of Negative Integers with Negative Integers
In this scenario, when a negative number is added to another negative number, it becomes a subtraction. For example: -4 + (-2) = -2.

Figure 5 Subtraction of Negative Integers from Negative Integers

e. Subtraction of Positive Integers from Positive Integers
In this condition, when a positive integer is subtracted from another positive integer, it results in the subtraction of integers. For example: 4 - 2 = 2.

Figure 6 Subtraction of Positive Integers from Positive Integers

f. Subtraction of Positive Integers and Negative Integers
In this condition, when a positive integer is subtracted from a negative integer, the result is addition. For example: 4 - (-2) = 6.

Figure 7 Subtraction of Negative Integers from Negative Integers

g. Subtraction of Negative Integers from Negative Integers
In this condition, when a negative integer is subtracted from another negative integer, the result is addition. For example: -4 - (-2) = -2.

Figure 8 Subtraction of Negative Integers from Negative Integers

Discussion

This Android-based integer operations learning educational game application for elementary school students has been tested in schools to find out the effectiveness of this media. According to one teacher at SD N 1 Yogyakarta, learning media through educational games really helps students in learning mathematics. Apart from that, this application has been tested on 15 students in class 2 of SD N 1 Yogyakarta. The responses from the students were that most of them liked it and really felt that it made it easier for students to learn mathematics, especially whole numbers. The development of educational games for learning mathematics, particularly integer operations, has shown promising results in enhancing elementary school students' interest and engagement in the subject. Sarifah et al. (2022) emphasized the significance of developing educational games to increase students' interest in learning mathematics at the elementary school level. This aligns with the need to create engaging and interactive learning experiences for young learners. Additionally, Nisa et al. (2022) highlighted the development of mobile learning apps focusing on integer operation materials as alternative media. This demonstrates the potential of utilizing technology, such as Android-based educational games, to provide interactive and accessible learning platforms for elementary school students. These references underscore the potential benefits of using educational games, particularly those based on the Android platform, to enhance the learning experience and interest of elementary school students in mathematics, specifically in the context of integer operations.

By leveraging the insights from these studies, the development of an Android-based educational game for learning integer operations can be tailored to provide an engaging and effective learning tool for elementary school students. The incorporation of interactive features, visual representations, and gamified elements can contribute to creating a stimulating learning environment, thereby fostering students' interest and understanding of integer operations. In conclusion, the development of an Android-based educational game for learning integer operations holds the potential to enhance elementary school students' engagement and interest in mathematics. By drawing from the findings of existing research, the design and implementation of such a game can be informed by best practices and

insights into creating effective and captivating educational experiences for young learners.

CONCLUSION

Based on the research conducted by the developer, it can be concluded that the educational game for learning integer operations for elementary school students based on Android is suitable for implementation in the learning process. The feasibility of the media is considered in several aspects such as: The existence of this educational game for learning integers has increased students' interest in learning mathematics, evidenced by the high enthusiasm of students to try this educational game for integers. After being tested on several students at State Elementary School 1 Yogyakarta Pringsewu, it was found that the understanding of integers became easier for students, aiding them in comprehending and operating addition and subtraction of integers. As a recommendation from this research, for the system that has been developed to be utilized effectively, there is a need for socialization regarding the use of the educational game application for learning integers among teachers and students. This will ensure smooth operation. Additionally, there is a suggestion for the development of more comprehensive content, such as the addition of topics on fraction and prime numbers.

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