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Games-Based Interactive Multimedia to Increase Student Creativity in Physical Education Course

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ABSTRACT

Purpose: This research aims to produce game-based interactive learning media that positively impacts students' creative thinking skills in physical education courses. **Methodology** This research was conducted with fourth-grade students at the elementary schools of Koja Sub-District in North Jakarta with a sample using the Slovin formula of 80 students asked to fill out a questionnaire using experimental research methods. The collected data were analyzed using a normality test, homogeneity test and t-test. **Findings** The normality test using Kolmogorov-Smirnov showed that $p = 0.200 > 0.05$, suggesting the data have a normal distribution. The homogeneity test showed that the significant value increased 0.071 larger than 0.05, showing that the tested data were homogeneous. Based on 80 students who had filled out the questionnaire, the results of the t-test displayed that Sig. (2-tailed) had a value equal to 0.000, which was less than 0.05. It showed that multimedia game-based learning positively impacted student creativity use in education. **Implications to Research and Practice** This research contributed to the digitization of elementary schools through technology in the teaching and learning process.

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Introduction

Currently, digital-based learning transformation is becoming the primary strategy to face the challenges of the Industrial Revolution 4.0 era, where the process of transmitting information is speedy and covers a wide area (Baygin et al., 2016; Benešová & Tupa, 2017; Oke & Fernandes, 2020; Shahroom & Hussin, 2018; Svela et al., 2019). In the modern era like today, information technology develops according to human needs to assist humans in carrying out their activities. One is the number of technologies used to obtain information (Novaliendry et al., 2021). These technological advances have helped many industries to develop, including educational institutions. The importance of educational technology in teaching is because of its use for information and communication technology. Furthermore, it is said that students and teachers see the effectiveness of learning techniques (Morsidi et al., 2021).

Technology entry into the world of education helps students get new information. Since the entrance of the COVID-19 virus, the government has begun to establish learning at home, and educators in schools have also changed the education system so that it continues to run correctly. They were coupled with the Generation Alpha lifestyle in line with the advancement of the digital era. The development of digital technology has influenced them to adopt digital mobile devices in their daily life routines, including their learning activities (Cerezo, Calderón, & Romero, 2019; Choi, Land, & Zimmerman, 2018; Cieza & Lujan, 2018). Therefore, educational institutions are turning to online learning to deliver learning materials effectively (Daniel, 2020). However, online learning is crucial because not all regions have adequate information and communication technology (Hermawan, Deswila, & Yunita, 2018). Online learning has now become commonplace in the last few decades. Learning to teach using mobile devices such as smartphones and tablets is now a trend (Becker et al., 2020; Papadakis & Kalogiannakis, 2018). The benefits of high-quality education and learning are numerous (Kalogiannakis & Papadakis, 2017).

With the influence of technology, education in the future will be more relaxed and two-way, diverse, multidisciplinary, and related to work productivity and competition. However, concepts and mechanisms of teaching and learning (education) based on concepts and mechanisms cannot be avoided (Novaliendry et al., 2020). Therefore, the development of this era is expected to make a more advanced generation with the use of online learning. Online learning is also known as E-learning. E-learning transforms conventional education into digital form in terms of content and systems. The world community has widely accepted the concept of E-learning, as evidenced by the widespread implementation of E-learning in educational institutions involving schools, training, universities, and industrial institutions, including Cisco Systems, IBM, HP, Oracle, Etc. The essence of E-learning is a form of conventional learning that is translated into digital format through internet technology.

Depending on its importance, E-learning can be used in distance or traditional education. It has developed into a learning model that does not only present subject matter on the internet but needs to be considered logically with learning principles. Likewise, with a development design that is simple, personal, fast, and includes online evaluations aiming at supporting lessons from both teachers and students to use multimedia features that can be used easily in everyday life and that can improve student learning outcomes (Amir et

al., 2020; Baric et al., 2019). Multimedia is one of the supporting devices that can be used in this case. This is because multimedia technology includes several synergistic aspects, including text, graphics, static images, animation, film, and sound (Suhairi et al., 2020). One form of multimedia that can be used in the learning process is PowerPoint.

Game-based interactive multimedia use Visual Basic for educational games or employ this medium as a container for multiple-choice questions and essays. It presents information in several formats, including audio, video, text, animation, and pictures. The purpose of educational games in this research is to produce a ready media filled with material content and scenarios to be exciting and increase students' learning motivation. By using educational games as learning media, especially in physical education learning, it is hoped that educators can be more professional in designing learning media. Educators only need a relatively short time to create exciting and interactive media to motivate students to participate in teaching and learning activities.

These game-based interactive multimedia can overcome learning difficulties and increase motivation. Furthermore, using interactive multimedia in learning can improve the expected thinking skills. In general, the benefits that can be obtained through the use of interactive multimedia are that the learning process can be more exciting and more interactive, the amount of teaching time can be reduced, the quality of student learning can be improved, and the teaching and learning process can be carried out. Moreover, the process can be done anytime and improve students' reasoning abilities (Suryanti, Widodo, & Yermiandhoko, 2021).

This study used game-based interactive multimedia media. This research was conducted based on the current needs of elementary school students accompanied by increasingly advanced technological developments. Therefore, this study focused on using interactive multimedia based on games to improve the learning outcomes of elementary school students in grade 4. This study also used interactive multimedia to show their use in educational games and describe the advantages of using interactive multimedia in education, including its impact on student competence. In addition, character building by integrating various character values were also presented in this study to enhance student character. These premises are based on an extensive review of past studies, both recent and relevant publications. Additionally, this research used the ADDIE model, a product development paradigm with procedures of Analysis, Design, Development, Implement, and Evaluate (Branch, 2009). The ADDIE model helped in critical analysis, synthesis, and evaluation to produce a clear picture of the theme of this research.

Literature Review

i.ADDIE Model

The ADDIE model became popular as a product development paradigm with its five stages: Analysis, Design, Development, Implement, and Evaluate. The Analysis phase is related to identifying the possible causes of the performance gap. The Design phase describes the verification of performances desired and the method of testing, to ensure they are accurate. Development phase is associated with generating and validating the resources of learning. Implementation phase is about the preparation of learning

environment and student engagement. Evaluation is connected with assessing instructional products and processes' quality before and after implementation.

The ADDIE model can be implemented when instruction is a relevant answer to a performance deviation. ADDIE conceptualization is appealed to build performance based on episodes assigned for the learning area. ADDIE gives a strategy to handle difficulty in intended learning conditions by countering various circumstances. The easiness of the ADDIE concept, consolidated with several prompts for inclusiveness, keeps showing its benefit.

ii.Interactive multimedia

Regardless of the impact of children's character formation during and after playing mobile learning games, learning games have different learning outcomes in the learning process and traditional games that previously existed in children's playing activities (Aisyah et al., 2018). Such mobile learning games are adapted to the current era. Many platforms are being used when designing mobile-based games, one of them is interactive multimedia. Playing games on interactive multimedia is a voluntary activity accompanied by feelings, excitement, and awareness (Sannikov et al., 2015). It is also a human beings' favourite way of learning and significantly impacting his or her skills, cognition, and social norms (Nazar, Putri, & Puspita, 2020). By playing interactive multimedia games, students learn more efficiently. Although identifying good games for education is complicated and time-consuming, they can help teachers improve student learning outcomes. In addition, a right game can always attract people of all ages, especially elementary school-age children (Petelin et al., 2019).

Various kinds and types of mobile learning games are multiplying, intending to provide convenience in facilitating children's learning in an interesting way (Dore et al., 2019). This game makes it easier for children to understand learning. Currently, not many children understand mobile learning games. However, the flexibility, efficiency, and various conveniences are found in mobile learning game applications that are user-friendly and can solve all developmental issues and help children achieve their goals and demands of learning, with or without the help of adults around them (Arifin et al., 2021; Pedro, Barbosa, & Santos, 2018). Learning through games is considered interesting because playing games like action games have a good impact on improving student learning. These games make students actively involved in the learning process.

iii.Creativity

Students' skills in the 21st century require critical thinking, creativity and innovation, communication, and collaboration (Karabatzaki et al., 2018). Creativity and innovation, particularly in essential in building both physical and mental condition at elementary, middle, and high schools. Several developments in the field of technology are based on this principle of creativity and innovation, which further contribute to changing the teaching and learning process. Creativity and innovation have also met the demands of technological development, and digital learning activities including games have been tailored to the needs of children (Boholano, 2017). As a result, teaching and learning processes use e-learning models and mobile apps such as audio, video, animation, images, and text.

Problem Statement

Many studies have been conducted on interactive multimedia (Sun et al., 2022; Suryanti et al., 2021; Uwineza, Uworwabayeho, & Yokoyama, 2023; Yang, 2023). These studies have paid attention to the improvement of students' learning outcomes. However, more studies need to focus on students' creativity, especially in physical education. Therefore, this research was conducted to develop game-based interactive multimedia and measure its impact on student creativity in physical education. This research is expected to improve teachers' professionalism in creating more innovative learning media through game-based interactive multimedia. In addition, it is also hoped that it can help teachers deliver lessons and support physical education learning activities more effectively to enhance students' creativity.

Hence, the research objectives framed for this study included: (i) to develop game-based interactive multimedia; (ii) to examine the impact of game-based interactive multimedia on student mathematics learning motivation. To achieve these objectives, two research needed to be answered: (1) How can we develop game-based interactive multimedia in a physical education course? (2) How does game-based interactive multimedia affect student creativity in physical education courses?

Methodology

- *Research Design*

This study used the Research and Development design and adopted the Analysis, Design, Development, Implement, and Evaluation (ADDIE) Model to evaluate the data. The data was collected from students at elementary schools in the sub-district of Koja in North Jakarta, Indonesia. This experimental design utilized in this study is shown in Table 1. In the group experiment, student learning outcomes were applied using interactive multimedia based on the game. The participants were divided into two groups-experimental and control. Though the study adopted different methods for each group, no treatment was suggested for the control group. Table 1 presents the design of this study.

Table 1

Experimental Research Design

Groups	Treatment	Post-Test
E	X	O_1
C	-	O2

Description:
E = Experimental group
C = Control group
O1 = Experimental posttest
O2 = Control posttest
X = Game-based interactive multimedia

- *Research Sample*

This study made use of a random sampling method to choose participants for the study. These participants belonged to the elementary schools in Koja, North Jakarta City, DKI Jakarta. A total of 160 participants were selected and divided into two groups, experimental and control, each group comprising 80 students.

- *Research Instrument and Procedure*

The instrument for this study was designed to determine the effectiveness of using game-based interactive multimedia on creativity in physical education courses for fifth-grade elementary school students. The content validity and construct validity of the instrument were assessed in order to ensure that its content reflected the desired objective. Hence, the content validity was carried out by experts on the subject while construct validity was carried out by calculating the validity test using the Product Moment Correlation Technique.

- *Data Analysis*

The study analyzed the data with the Kolmogorov Smirnov for the normality test, the Levene's Test for measuring homogeneity, and the T-test for testing the hypothesis with a significance level of 0.05. The normality test used the Kolmogorov Smirnov formula with the Asymp rule of Sig or p-value at a 5% significance level. The homogeneity test used a paired sample t-test to find out whether there was a difference in the mean of the two paired samples. Both the normality and homogeneity calculations were carried out with SPSS version 22.0.

Results

1. Analysis

The product of game-based learning begins with a procedure started with validating the performance gap seen as a problem in fourth-grade students at the Koja District Elementary School. The low student grades was seen as a big issue, which had caused their creativity to decline. This was caused by learning media that could be more attractive, making students feel bored quickly and affecting the lesson's value. Therefore, game-based learning media is created, which was expected to enable students to overcome existing problems and help develop their creativity in understanding learning.

2. Design

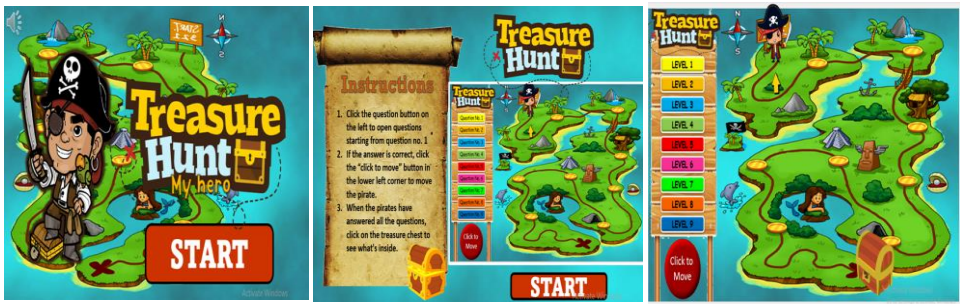
This procedure verified the student performance desired and confirmed the appropriate method of testing to measure student creativity. This step began with the preparation of data collection instruments for pre-test and post-test questions related to estimating the students' creativity in physical education, which were carried out at the beginning and end of learning. The design stage was helpful as an initial basis for designing game-based learning media developed by compiling a plan or process for making this product through learning media framework development as a reference.

The selection of media considered the charactereristics of the participants. It was felt that the interactive media attracted students' attention to learning and remembering the material more efficiently, improving students' creative thinking skills in physical education subjects. For example, in a game a pirate guided students to search for treasure chests by answering 'my hero' material questions. Such game-based learning media were of very elementary level so that fourth graders can easily understand the material for my hero in the physical education course.

3. *Development*

The development stage required to adopt a procedure to generate and validate the content of the learning resources. In this step, selection and development of the supporting media of game-based interactive media was done according to the problems experienced by fourth-grade students. In this step, student and teacher guidance material was also developed, continued by conducting formative revisions and a pilot test. The product developed can be seen in Figures 1 (a to c).

Figure 1 (a) is the main screen where the game started. In the initial view, there was a pirate who helped the game run. On the right was a start screen for starting game-based learning media. This game was accompanied by supporting background voices so that the atmosphere of playing games while learning was more pronounced. Figure 1 (b) listed a few instructions to explain how to play this learning multimedia. On the right was a map showing the current position of the pirates.



(a) **(b)** **(c)**

Figure 1. *Interactive Game based learning*

Figure 1 (c) shows a question display on the left side to help the pirate reach his destination. The player would click on question to begin the game, and when the question is answered, the pirate's position will change. After all the questions are answered, the pirate would find the treasure.

4. *Implementation*

The Implementation stage arrives after preparing the learning environment and engaging the students by arranging the students and the teacher to be ready to implement the game-based learning media in the teaching-learning process. During the implementation stage, there are a few small field-scale tests to test the game-based learning

media. Prior to implementation, a media feasibility assessment sheet based on learning games for physical education courses was prepared for validators, material experts and media experts. It was required that material experts would assess the instrument developed for a good visual media preparation and the media experts would follow up the preparation of visual elements in good learning media.

This kind of validation was imperative looking at the problems of fourth-grade students in understanding 'my hero' game material and testing the game-based multimedia. Table 2 and 3 summarize this validation process by material and media experts, prior to the implementation of the interactive game-based learning material for the physical education courses.

Table 2

Research aspect instruments for material experts

No	Assessment Aspects	Indicators	Number of Items
1	Validity	Content truth	3
		Material Updates	2
		Systematic and Logical	2
2	Level of Interest	Conformity of Material Formulation	2
3	Usefulness	Academic benefits	2
		Non-academic benefits	3
4	Learnability	Possibility to learn	2
5	Interesting	Interest to learn	2
		Motivation	2

Table 3

Instrument aspects for media experts

No	Assessment Aspects	Indicators	Number of Items
1	Simplicity	Layout	2
		Language	3
		Integration between visual elements	5
2	Cohesiveness	Emphasis on visual elements	3
3	Emphasis	Visual element balance	2
4	Balance	Line visuals	2
5	Line	Shape visuals	2
6	Form	Space in design	2

5. *Evaluation*

Finally, the Evaluation procedure assessed the quality of game-based learning media products and processes before and after implementation by determining evaluation criteria, selecting tools, and conducting evaluations. This study used normality test with Kolmogorov-Smirnov method to present that $p = 0.200 > 0.05$, suggesting that the data had a normal distribution. The homogeneity test also showed that the significant value gets 0.071 larger than 0.05, showing that the tested data are homogeneous. The t-test results, which are presented in Table 4, show Sig's value. (2-tailed) Equal to 0.000 less than 0.05, indicating that implementing game-based learning media can develop student creativity.

Table 4

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence The interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	3.480	.071	-7.533	35	.000	-35.526	4.716	-45.100	-25.953
Equal variances not assumed			-7.640	28.937	.000	-35.526	4.650	-45.037	-26.015

Discussion

The results of the study confirmed that applying game-based learning media can help students boost their creativity. Krisbiantoro (2020) confirms that gamification effectively enhanced student creativity. Furthermore, managing a classroom based on a gamified teaching strategy stimulated elementary school students' divergent thinking and tendency to be creative (Chen, Chang, & Wu, 2020). Another study revealed a significantly positive relationship between the effectiveness of applying gamification in teaching and learning and the creative thinking of students at primary schools (Aljraiwi, 2019). In addition, Lyons, Fox, and Stephens (2023) study highlighted that student involvement was significantly affected by student's perceived learning and engagement related to gamification. This study found that gamification can strengthen student engagement and upgrade higher-order learning.

This research revealed that the gamification mechanism can make the students develop a positive emotional touch, and they demonstrate high attentiveness, leading to entering learning activities with complete commitment and enabling them to immerse themselves in learning. This is similar to the research of Bulut, Samur, and Cömert (2022), who suggested that with the help of media with educational games, physical education classes can be more enjoyable and can improve the student's ability to instantaneously create ideas to face problems, leading to enhancing creative thinking skills. Besides, the students acquired fascinating information from their learning, and their viewpoint is recognized as more innovative, and they have more opportunities to collaborate in learning activities. In addition, gameplay is significantly positively associated with student creativity and confirms that learning immersion has an intermediary role between the students' creativity (Zhang, 2022).

Similarly, Behnamnia et al. (2020) also highlighted that learning based on digital games can help students' creative skills. The students can undergo suitable time for absorbing the creative thinking procedure in their activities and

motivating them. Duncan (2020) also states that the growth of twenty-first-century learning skills of students with activities using game-based learning is significant, as well as student participation. Lastly, Behnamnia et al. (2020) confirmed that application technologies of digital game-based learning could potentially augment student acquisition of creative skills, knowledge transfer, and positive attitude toward learning and insightful learning. The students have practical knowledge and chances to grasp the process of creative thinking in learning activities through educational digital games. This study provides new awareness, guidance, and fruitful recommendations on enlarging creative skills and learning achievement with digital game-based learning.

Conclusion and Recommendations

The results of the study suggest that students exposed to game-based learning in the interactive learning media showed more positive effect on their cognitive aspects. These educational games improved their learning, creativity, critical thinking, and problem-solving skills. The tests conducted to measure the student learning outcomes revealed that students of fourth-grade understand more efficiently and positively the values and creativity at elementary schools in the Koja, North Jakarta City, Province DKI Jakarta sub-district Indonesia. The study has several implications. The findings of this study would help teachers and academicians to design and include interactive media in their instructional curriculum. The students would also learn through feelings of excitement and fun, and would stimulate their learning. The administrators could also configure game environments to adjust the difficulty levels in games based on the grade or level in which these games are introduced.

The present study faced certain limitations as well. First, the data collection was based on ADDIE model which had a few restrictions. There was no way to find out whether any factor negatively contributed to students' creativity and motivation while playing the game. Secondly, this game was limited to one single institution and studied upon elementary students only. While implementing the findings of this study, there would be issues of generalizability. Future research studies could extend to other educational contexts. Thirdly, this study did not make any comparison of the experimental and the control group, nor suggested any intervention for the control group. The reason was that both groups were homogenous and it was not possible to analyze their motivation and creativity on a common game based interactive media.

The study would like to make the following recommendations. Schools should issue relevant guidelines and instructions, as well as tools to make use of the game based interactive learning media to find learning solutions. The students should also have the access to infrastructure and guidelines to practice these games to ensure that they learn the game mechanics to improve their creativity.

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