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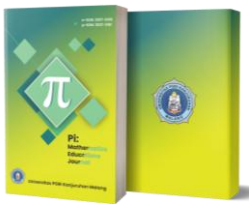

Development of Adventure-Based Educational Games to Improve Critical Thinking Skills and Interest in Learning

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ABSTRACT
Games are widespread in society, not only among children but adults also play games. It is not uncommon for school-age children to play this game until late at night which of course interferes with their study time. In this study, the researcher developed an educational game called "Math Adventure". This educational game makes students learn while playing because, on the one hand, students play but on the other hand it is also useful to provide education or lessons for students. The educational game "Math Adventure" developed by the researcher contains questions from the two-variable linear equation system material. The game "Math Adventure" is a type of adventure game in a maze where the character will look for the correct answer in a box or room in a maze. There are 4 answers available and are spread across 4 different rooms. The game "Math Adventure" has gone through a validation process by two validators and has been tested on 5 students. In the validation process, the game "Math Adventure" was declared valid and worth testing. Based on the results of the students' responses after being tested the game "Math Adventure" received a good response from the students. The game "Math Adventure" can be used as an alternative for teachers to improve students' critical thinking skills and students' interest in learning in mathematics lessons.

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1. Introduction

Education is a dynamic of life that occurs throughout life that brings a positive influence where knowledge transfer occurs [1]. According to Law number 20 of 2003, education is "a conscious and planned effort to create a learning and learning atmosphere so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble morals and skills needed by themselves and society". In line with this definition of education, the Indonesian government aspires to educate the nation's life as stated in the 1945 Constitution. However, looking at the existing reality, Indonesian education has not been able to compete with neighboring countries.

The quality of education in Indonesia is still inferior when compared to countries in Asean such as Singapore. Indonesia is a developing category country with an inadequate level of education [2]. This is caused by several factors including malnutrition in children. Indonesian children do not like to consume milk, low quality of education, contextual ways of learning, lack of literacy, and lack of innovation from research bodies [2]. When viewed from the field of mathematics in Indonesia, mathematics skills in Indonesia are still inferior to neighboring countries such as Singapore.

Mathematics has an important role in life so that mathematics learning also develops according to the demands of the times where technology is increasingly sophisticated [3]. The development of mathematics learning can be seen from the use of technology-based learning media in lessons. Educators are starting to use video content in delivering lessons in the classroom. Increasingly advanced technology brings very significant benefits in the world of education.

The development of technology is very influential in the world of education, for example helping students in learning and also teachers in developing teaching skills [4]. As for students, it is easier to access materials related to certain subjects, especially mathematics. For example, ChatGPT, Gemini and so on who use Artificial Intelligence. Development in the world of education also continues. In education, it is also beginning to be developed Game education, development of e-module-based teaching materials, development of android-based student worksheets and many more.

Today's technology is more towards the development and use of scientific procedures in obtaining truth based on laws and rules with the aim of facilitating learning [5]. Development according to the Great Dictionary of the Indonesian Language is a process of making something or changing it for better or renewable. One example of development is the development of Game education. Game Education is an interactive learning medium. Interactive learning media Game proven to provide positive results in learning and receive positive responses from students [6]. The researcher also said that the use of technology in Game Education as an intermediary in teaching and learning activities can make it easier for teachers to convey learning materials in improving student understanding.

The difference between this research and previous research entitled "Development of Interactive Multimedia on Set Material Based on Puzzle with a Contextual Approach" lies in the material used and the media developed, which in the previous study was puzzle-based interactive multimedia. The similarity between the two studies is that both use the Research and Development method and focus on developing learning media. Another previous study entitled "Development of Android-Based Educational Game on Animalia Material for Grade X Senior High School/MA Students" differs from this research in terms of the subject matter and the research target. Although both studies focus on the development of educational games, the games developed are significantly different. The game developed in this research is an adventure game that takes place in a maze, where players must find the correct answers to the given questions. Both studies use a website called Wordwall, but with different templates. The previous research used a random template, whereas this research uses the maze chaze template.

Children tend to prefer to play whether it's playing in old-fashioned or manual games or playing in Game. Children are now morefond of playing Game. Based on the researchers' observations, many children have also experienced addiction to Game [7]. Game which is rampant in society causes its own anxiety for parents, for that it is also needed Game which is educational so that children who play this game can learn and develop. Research conducted by [8] concludes that in playing Game Contains education that can train problem-solving skills. This problem made the researcher develop Game education that is specifically

designed to improve students' mathematical skills, especially in the material of the Two-Variable Linear Equation System. Game This education is a Software developed in Wordwall Website which will be played on electronic devices, both Android and laptops. With the development of Game This education is expected to help students in developing students' mathematical abilities.

Mathematical abilities consist of cognitive and affective abilities. One example of cognitive ability is the ability to think critically. Critical thinking is the skill of recognizing, analyzing, finding solutions and deducing and solving problems and distinguishing between right and wrong information [9]. The ability to think critically is an important ability in the world of education. Critical thinking itself as a tool in compiling knowledge [9]. An example of affective ability itself is the interest in learning. These two examples of mathematical abilities are expected to develop with the development of Game education.

Based on the description above, this research is expected to improve students' mathematical skills and can also be useful for the world of education. The mathematical ability in question is cognitive ability in the form of critical thinking skills and affective abilities, namely interest in learning mathematics. This research is also expected to help teachers find teaching solutions using game-based interactive learning media. This research is also of course very useful for the researcher himself in developing learning media and developing skills in writing.

The purpose of this research is to improve students' critical thinking skills as well as to increase children's interest in learning. The urgency of this research lies in the rapid development of technology and the widespread circulation of non-educational online games, which result in addiction among students.

2. Methods

Development research Game Adventure-Based Education to Improve Mathematical Skills is Research and Development (R&D) with ADDIE expansion or Analysis, Design, Development, Implementation and Evaluation [10]. The stages include (1). Phase Analysis It is a stage where the researcher collects information related to the curriculum in the school, the character of the student and the purpose of learning. The information obtained is then used as a basis for development Game education. (2). Stage Design is the stage where the researcher designs or creates Game adventurous education. The researcher uses the template in wordwall from Maze Chase then develops problems with the Two-Variable Linear Equation System material. The questions are adjusted to different levels of difficulty. The target is students of SMP PGRI Pakisaji 01 grade IX. (3). Stage Development is a refinement of the previous stage, which is to adjust the time used in the Game, and perfect. Game This is played by answering the questions given by moving the characters in the maze until they enter the box where the answer is correct. The threat is in the form of pawns placed on the streets in this maze. There are two types of pawns, namely green and red pawns. The green pawn will move in a regular manner while the red pawn will move according to your character. When you meet a pawn, one life will be lost. There are 3 lives available. After it is completed, it will be validated. Validation is carried out by 2 validators. (4). Stages Implementation carried out after development Game This adventurer is declared valid. The experimental stage was carried out on a group of junior high school students in grade IX who were randomly taken. This experiment is carried out with the aim of ensuring that students provide responses and suggestions related to Game This can then be implemented in the classroom. (5). Stage *Evaluation* At this stage, the researcher will evaluate whether the developed game is a valid and practical learning medium. Declared valid when the validator provides validity results with sufficient to very good values. Meanwhile, it was

practically obtained from a questionnaire filled out by five students and selected randomly. This research occurred in a group of 20 junior high school students in grade IX. The instruments of this study were questionnaires from students and validation from validators. The analysis technique was carried out by analyzing the responses of validators and students.

A. Validity Analysis

According to [11] the assessment of validity and practicality analysis uses a Likert scale table as follows.

Table 1: Responses to Validity Analysis

Respond	Weight
Not sure	1
Don't agree	2
Simply agree	3
Agree	4
Strongly agree	5

The subsequent step involves calculating the validity of the educational game by applying the following percentage formula

$$\text{Presentation} = \frac{total\ score\ obtained}{maximum\ score} \times 100 \quad (1)$$

Table 2: Validity Analysis Criteria

Criteria	Presentage (%)
Invalid	0-20%
Not valid	20,1-40%
Fairly valid	40,1-60%
Valid	60,1-80%
Very valid	80,1-100%

B. Practicality Analysis

Tabel 3: Practicality Analysis Responses

Category	Weight
Not Sure	1
Don't agree	2
Simply agree	3
Agree	4
Strongly agree	5

The next step involves calculating the validity of the educational game through the following percentage-based formula

$$\text{Average} = \frac{total\ student\ score}{number\ of\ student} \quad (2)$$

$$\text{Persentage} = \frac{\text{average}}{maximum\ score} \times 100\% \quad (3)$$

Tabel 4: kriteria analisis kepraktisan

Kriteria	Presentage (%)
Not practical	0-20%
Not practical	20,1-40%
Quite practical	40,1-60%
Practical	60,1-80%
Very practical	80,1-100%

3. Result and Discussion

The adventure-based educational game "Math Adventur" was developed based on ADDIE's development model with stages, namely at the stage of analysis of the results of observation showing that the game has made children become addicted and forget their main task as learners, namely learning itself. This makes it uneasy not only for parents but also for teachers at school. The observation made by the researcher is that almost all students have an android mobile phone and must have online digital games such as the popular ones namely freefire, mobile legend and also pubg. Based on the researcher's observations, the researcher then took steps in developing an educational game with the concept of adventure in a maze.

At this stage, the researcher uses the tamplate of the wordwall by upgrading the wordwall website. The researcher used an upgraded pro template, namely *a* maze chaze or maze. This tamplate is in the form of a maze that is guarded by two types of pawns which are green and red. The green guard pawn moves regularly according to its path while the red pawn moves according to your character. The character we use will try to dodge the guard pawn and enter a maze containing the correct answer. There are 3 heart characters available if all three have been used, the game ends and the points earned depend on the correct answer. The following is shown the in-game image.

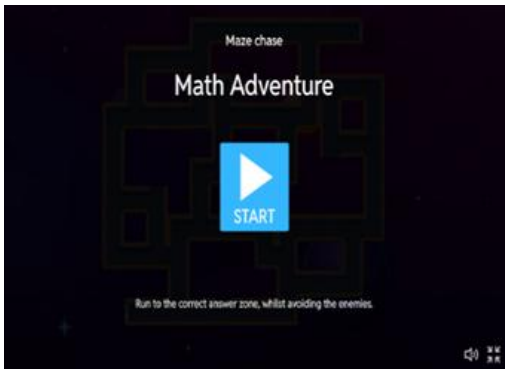

Figure 1. Early game view

Figure 1 shows the initial look of the game ″Math Adventure″. In this image there is the name of the game and the name of the template used and there is a start button to start the game. There are also buttons to zoom in and sound.

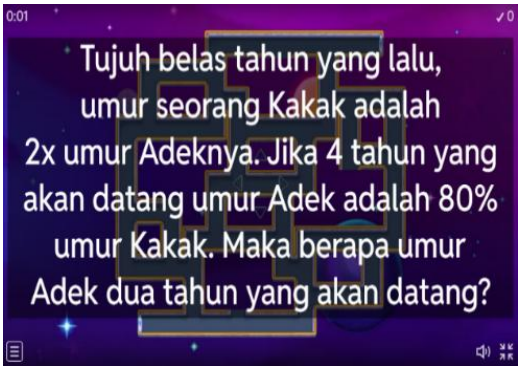

Figure 2. Question display

Figure 2 shows the questions that students must do. The answer to this question is found in the maze. Players will move their characters into a maze that contains the correct answers.

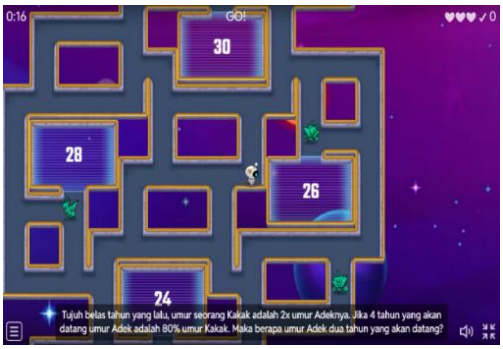

Figure 3. Game view in progress

Figure 3 shows an answer maze where players will look for answers to questions that have been worked on in the maze. The player will be blocked by a guard pawn that is blocking the way. If caught by a pawn, it will reduce the player's life. If you enter a maze that contains the wrong answers, it will reduce the player's life.

Figure 4. Display when the answer is correct

Figure 4 shows the correct answer. Players will get one point from the correct answer. The next stage is development, where the researcher develops the game by adding questions in it according to the two-variable linear equation system material. This question can be changed according to needs. The researchers also adjusted the time used to make it longer to play games. After development, the researcher will conduct a validation test from two validators. The following is a table of validation results

Table 5. Table of results of Media Validation of the Game "Math Adventur"

Validator	Percentage	Category
1	95%	Highly feasible
2	94%	Highly feasible

The table above shows the percentage of validator score 1, which is 95% with a very feasible category. Validator 2 with a score percentage of 94% is in the very feasible category. The average score percentage is 94.5% in the very decent category.

The results of the questionnaire show that the media Game Education "Math Adventure" is very suitable for use with minor revisions. It states Game education ″Math Adventure″. [12] said in his journal that the importance of validation tests in declaring the feasibility of using the developed media. In line with [13] that the validation test is carried out so that the media developed is in the form of revisions so that it can be tested further.

Game Adventure education that has gone through a validation and revision process was then tested on a group of junior high school students in grade IX who were randomly selected. First, students are introduced to Game education of adventurers with two-variable linear equation system materials. Next Game distributed in the form of barcodes and links through WA then the researcher explained how to play Game adventure. After the students successfully scan the barcode that has been distributed, the students begin to enter the Game and start operating. Game Adventure Education received a good response from students. Students look happy to play Game and students also show high enthusiasm in playing Game. [14] said the trial was carried out to find out the feasibility of the media Game that has been developed. Learn More [15] also said that the media trial Game It is carried out to get a direct response from the students involved so that the developed media is declared suitable for use.

Advantages of the game ″Math Adventure″ is the existing problem that can be changed according to our needs. In general Game Education has an excellent role in improving student learning outcomes [16]. In the Super Mathrio Bros game research, the Unity 2021.3.8f1 application and Visual Studio Code were used. The researcher designed code to control the player, generate obstacles, display questions, and evaluate answers. The questions involved numbers and arithmetic operations. Many features were developed in this study. The research developed here uses the Wordwall website, where a maze chase template is available and was utilized in this development. Further [17] says that Game Education can also increase students' demand for learning in learning

4. Conclusion

The development of the educational game “Math Adventure”, based on the ADDIE development model, has successfully gone through the stages of Analysis, Design, Development, Implementation, and Evaluation. This game was specifically created to address the issue of students’ overexposure to non-educational digital games, by offering an engaging alternative that supports the learning of mathematical concepts, particularly the two-variable linear equation system. During the Analysis stage, it was found that students were frequently distracted by popular online games, which negatively affected their academic focus. In response, the Design stage incorporated a maze-based game format using the Wordwall Maze Chase template, integrating mathematics problems at various difficulty levels suitable for 9th-grade students. At the Development stage, interactive gameplay was enhanced through obstacle features, time limits, and scoring mechanisms based on correct answers. The game was then validated by two expert validators, achieving an average score of 94.5%, categorized as "Highly Feasible". This confirms the validity of the media as an effective educational tool. The Implementation phase involved a small-scale trial among 9th-grade students, who responded positively to the game in terms of engagement and usability. Feedback was gathered using questionnaires, with results showing that the game met the "Very Practical" category based on student responses. The Evaluation phase confirmed that "Math Adventure" is both a valid and practical tool for improving students' mathematical skills and increasing their interest in learning. The flexibility to modify problems within the game also adds to its effectiveness and adaptability across different topics or grade levels.

Overall, this research demonstrates that adventure-based educational games, when properly developed and validated, can serve as powerful learning media that are both interactive and educational. Such tools can play a significant role in enhancing students’ critical thinking, engagement, and learning outcomes in mathematics. "Math Adventure" in the material of the two-variable linear equation system for grade IX junior high school, it can be concluded that the learning media Game Education meets the criteria of feasibility, flexibility in use, and effectiveness in supporting teaching and learning activities. The results

of the students' responses showed that there was an increase in students' interest in learning in mathematics subjects, as well as making the atmosphere in the classroom more enjoyable. Moreover, game education ″Math Adventure″ It also has the potential to be an alternative for teachers in overcoming passive learning into more interactive learning.

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