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Enhancing student interest in learning through the development of serious mathematics games

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Abstract. Learning mathematics in Indonesia today has not given the expected results, it is not better when compared to other countries. If a student is active and able to count quickly and carefully in mathematics, then the student will indirectly be easier to solve problems either in mathematics itself or applied in everyday life. The average educator has not used interesting media to improve children's numeracy skills, there are often difficulties in students' mathematics learning. Many research contributions are directed at taking advantage of the success of video games and using them to benefit from the education domain. The concept of learning in this research is carried out by utilizing the development of information and communication technology through interesting mathematical game applications through web-based learning. The game is developed using scratch by MIT so that the development process is less time consuming and easier. The game is in form of the quiz that makes students utilize their mathematical skills to get rewards. In that way, the competitiveness of the students also increases at the same time with their numeric ability. This learning has an appropriate value to be a breakthrough to balance current technological developments and improve students' numerical ability. Because of the mathematics games has a rewards system, it is interesting for students to learn math.

1. Introduction

Mathematics learning in Indonesia currently has not given the expected results and is not better when compared to other countries, this can be seen from the results of the Program for International Student Assessment (PISA), that the percentage of Indonesian students under level 2 is very large 76, 6% and the percentage of students at levels 4, 5, and 6 are statistically absent [1]. The Organization for Economic Co-operation and Development (OECD) said that students under level 2 were deemed unable to function effectively in the life of the XXI century, therefore students' abilities needed to be further developed in learning mathematics in schools so that the Indonesian nation had the resources human power that can compete in the future life. Students should have cognitive competence after learning mathematics including "Thinking and reasoning, Argumentation, Communication, Modeling, Problem posing and solving, Representation, Using symbolic, formal and technical language and operations, Use of aids and tools"[1], so students can complete various mathematical calculations. Based on the results of the PISA test in 2018 the value of science, reading skills, and mathematics of Indonesian students is still low, number 72 of 79 countries in the world [2]. The PISA test value is shown in figure 1.



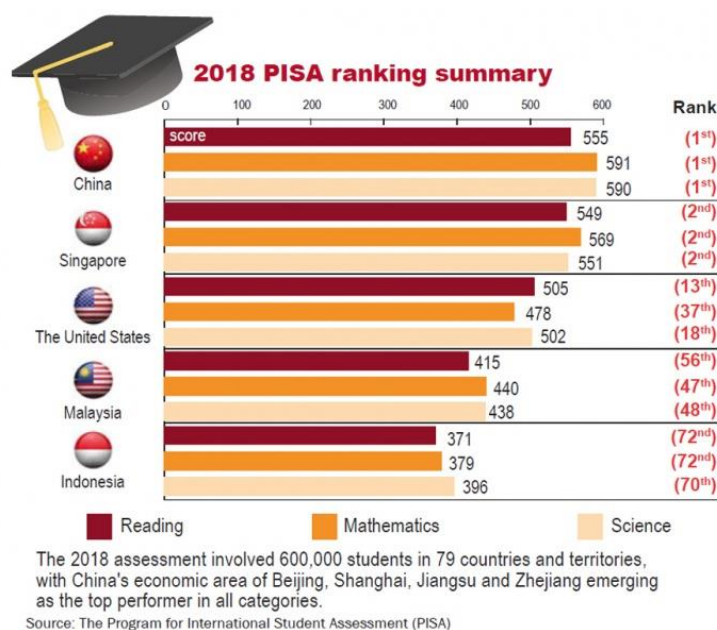


Figure 1. Pisa test results for Indonesia in 2018.

In line with what was conveyed by KEMDIKBUD [3], the creation of the 2013 curriculum aims to make individuals who are capable of productive and creative thinking. The importance of the ability to calculate, not only in mathematical problems but also in the everyday life of children, young people, and even parents [4]. If a child becomes active and can calculate quickly and carefully in learning mathematics, then indirectly the child will be easier to solve problems both in mathematics lesson or applied in everyday life, so that the child can solve problems and look for the right way out according to his ability.

Mathematics is not a difficult thing to learn as long as the delivery strategy is right and by the level of ability to learn it as stated by the Hakim that "in the teaching and learning activities, mathematics is one of the basic science that must be mastered by the student" [5]. Numeracy is the basis of other sciences, especially for the development of science and technology. The practice of learning to count requires learning media or teaching aids that serve to facilitate children to learn, but the average educator has not used attractive media to improve children's numeracy skills. , so that there are often difficulties in learning students' mathematics and cause reluctance to learn mathematics because the material in mathematics is considered difficult to understand because it is too abstract, plus the delivery of teachers who are too monotonous and boring is also one of the reasons why students do not like math lessons [6].

The concept of learning in this research was conducted by utilizing the development of information and communication technology through an interesting math game application through web-based learning. This game learning media has an appropriate value to be a breakthrough to keep pace with current technological developments and improve students' numerical abilities because of the exercises in the form of interesting games in applications that can be used alone as well as competed with friends during learning. so that the use of books that sometimes make students lazy to learn can be reduced.

2. Math and live skill

Mathematics is a subject that needs to be given to all students starting from elementary school to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together. Therefore, teaching and learning activities, especially in mathematics, need to be paid more attention to remember how important mathematics is for students to support their lives. Mathematics is a basic subject, in elementary or middle school, learning mathematics is very

important because in everyday life we cannot escape the application of mathematics [7]. In solving math problems, which mostly use numbers, numeracy skills are needed. Therefore, numerical skills are particularly important.

3. Serious games

Games are defined as physical and/or mental contests played according to certain rules, with the sole purpose of entertaining or entertaining participants. On the other hand, video games are a special type of game in which they are played on a computer according to certain rules for entertainment, recreation, or winning competitions.

Some perspectives are defining Serious Game or Applied Game as seen from academia and industry. For example, some industry figures believe that the Serious Game should include entertainment elements combined with a practical dimension [8]. The term game can be used to refer to any application that is produced using software developed by the gaming industry, which means that the majority of simulators will be considered as Serious Games [9]. Others argue that the Serious Game is just a computer game and that its classification is nothing more than a marketing technique [10]. The most common definition of a Serious Game is "a game that does not make entertainment or fun the main goal". Following this definition, Serious Games can be distinguished from video games based on their development goals, because Serious Games have a primary purpose other than entertainment.

4. Serious games in education

Many research contributions are directed to take advantage of the success of video games and use them to benefit from the educational domain [11]. Strive to use the addictive nature of games and the players' obsession with digital games to facilitate the players' learning process. As more and more young people spend hours playing video games, Quest to Learn, a high school that opened in September 2009 in New York City, is based entirely on a game-like learning model. In this school, students spend their day studying by playing games and designing them.

Several educational games were developed for classroom use, and the areas taught by them can vary widely. An example of such a game is Skills Arena which is specially designed for classroom use. The Skill Arena uses the Nintendo Gameboy and teaches students arithmetic skills at various difficulty levels. A study was conducted which involved elementary school students and concluded that playing technology-based games improved students' performance in mathematics [12].

5. Scratch

Scratch is a visual programming language for learning environments that allow beginners (whether students, teachers, learners, or parents) to learn to program without having to think about writing syntax completely wrong. This programming language was created by MIT Media Lab of the Massachusetts Institute of Technology with Scratch, users can create their animations, games, artworks, and more. Scratch users can create programs (called projects) by visually arranging command blocks (called blocks). In this way, students can focus on logic and programming flow (algorithms) without ever or frequently getting error errors due to incorrect syntax writing [13]. Scratch is taught to more than 800 schools and 70 colleges worldwide. In higher education, Scratch is used in Harvard University's CS50 introductory course.

6. Research method

The research approach used in the development research of this learning model is a development research approach. R&D is a process used to develop accountable educational products. The development of the learning model used in this study is the ADDIE (Analysis-Design-Develop-Implement-Evaluate) Learning Design Model with the consideration that ADDIE is suitable for developing learning model products that are right on target, effective and dynamic and are very helpful in learning development [14]. Figure 2 Shows the ADDIE model in general.

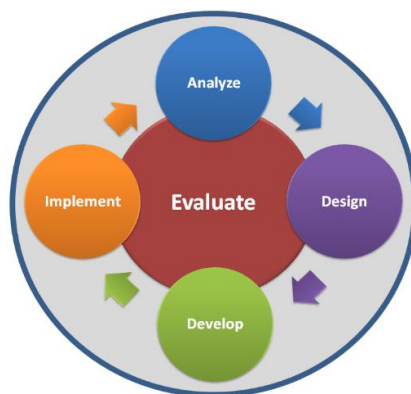


Figure 2. ADDIE Model.

6.1. Analyze

The Analysis stage focuses on the target audience. At the analysis stage, the instructional problems were defined, instructional objectives, learning objectives and identification of the learning environment and student's knowledge

6.2. Design

The design stage is related to targeting, assessment instruments, exercises, content, and analysis related to learning materials, learning plans and media selection. The design phase is carried out systematically and specifically. In this phase, learning media in the form of educational games were chosen which were developed with a scratch platform, this platform was chosen because it is easy to learn and is widely used for various levels of education. And games created using the scratch platform can be played on even low-spec laptops/computers if they have a web browser.

6.3. Develop

In the development stage, the creation and incorporation of the content that has been designed during the design stage are carried out. In this phase, storyboards, content writing and learning media are made.

6.4. Implement

In this stage, a procedure is made for students and facilitators. Training for facilitators includes curriculum material, expected learning outcomes, delivery methods and testing procedures. Other activities that must be done in this stage include distributing material and other supporting materials, as well as preparing for technical problems and discussing alternative plans with students.

6.5. Evaluate

Each stage of the ADDIE process involves formative evaluation. It is multidimensional and an essential component of the ADDIE process. It assumes a formative evaluation form is in the development stage. Evaluation is carried out during the implementation stage with the help of instructors and students. After the implementation of the learning is complete, summative evaluation is carried out to improve learning. The designer of the entire evaluation phase must ascertain whether problems relevant to the training program are resolved and whether the desired objectives are being met.

7. Results

The Created Games is in form of a quiz game, the students can choose the mathematical operation that he wants to practice, whether it is addition, subtraction, multiplication, or division. After students chose the operation students will be taken to a page with series of mathematical problems, there is music that makes students enthusiastic about doing the questions, then, at the end of the game, if there are more

correct answers than wrong answers, the students will get rewards, that is, they can play songs according to the students' wishes. Figure 2 shows some of the screenshots of the game

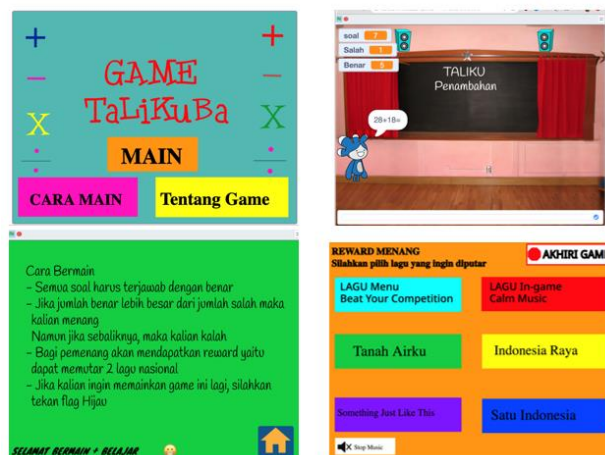


Figure 3. In game screenshots.

Games especially computer games along with learning-teaching activities help the learning of the student and increase its inner motivation and interest by creating challenges and giving control of the game to the player. Training and repetition with custom settings make the memorizing contents easier for the students [15].

NO	Assessed Aspects
Interface Design Aspect	
1	background color mix
2	The combination of writing colors with a comfortable background to the eye
3	Sound and image selection
4	Text color selection
5	font selection
6	the position of the image and character are right
7	game display design
8	Color selection of operator symbols
9	clarity of the rules of the game
10	Music Selection
Game Presentation Aspect	
11	Easy to Use Game
12	Easy to understand Game Instructor
13	Understanding of writing or text in the game
14	use the right language
15	The images presented are appropriate
Aspek Pemrograman	
16	Easy to Operate the symbols presented
17	Game animation settings
18	The suitability of the used operator symbol
Aspek Isi Game	
19	Students can understand the operations of addition, multiplication, subtractions, and division through the game media
20	Match the level of difficulty of the game in accordance with the ability of elementary students

Figure 4. Questionnaires design.

8. Evaluation plan

The Evaluation will be done in SDN Tunjungsekar 1, consist of 4 stages (Validation, Small Group Testing, Large Group testing, Release):

- The Game will be validated by mathematicians, ICT experts and elementary school teacher teachers. If the validation results are good, then we will move to the next stage.
- The Game will then be tested to small groups of students. Each student will be asked to play the games that have been designed. Then The students will be asked to provide assessments through the provided questionnaire sheet and give advice and comment on the game (see figure 4). If the results of the assessments are good, then we will move to the next stage.

- The game will be tested in a large group, and they will also be asked to give the assessment through the provided questionnaire sheet and give advice and comment on the game. If the Results is Good, then we will move to the next stage.
- The game is ready to be released.

9. Conclusion

The game is developed using scratch by MIT so that the development process is less time consuming and easier. The game is in the form of a quiz game that makes students utilize their mathematical skills to win the quiz and get the rewards. In that way, the competitiveness of the students also increases at the same time with their numeric ability. This learning media has an appropriate value to balance current technological developments and improve student's numerical ability because of the exercises in the form of interesting web-based games. The game can make learning math interesting for the students because of the interface and the reward system. Further Evaluation plan still needs to be done before releasing the game to the public.

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