

GAME-BASED LEARNING MEDIA FOR NUMBER TOPIC: ANALYSIS AND DESIGN

Nilza Humaira Salsabila, Hapipi, Ulfa Lu'luilmaknun

Abstract

This study aims to describe the preliminary analysis on the development of game media and see the student's preliminary response to the developed game-based mathematics learning media that is oriented to the learning outcomes of junior high school students. Several previous research results have shown that game-based learning media can improve students' mathematics learning outcomes. The development of learning media is based on the ADDIE development model which consists of five stages, namely, analysis, design, development, implementation, and evaluation. The respondents in this study were junior high school students totaling 122 people. Students are given a questionnaire related to game development. The questionnaire consists of 5 closed statement questions, with 4 answers on a Likert scale, namely strongly agree, agree, disagree, strongly disagree. The results show that most students agree that game learning media is needed in number topic, game learning media that can be played on mobile phones will make students easier to learn, the display of the game media is attractive, the color combination in the game media is interesting, and the characters in the game media are interesting.

Keywords : Game-Based Learning; Number Topic Media

Introduction

The rapid development of technology today can be used to improve the quality of education. The Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 24 (2016) also reveals that learning must be in accordance with technological developments, so learning should also be able to use advances in information and communication technology as a means, learning resource, and learning tool. NCTM (2000)

suggests the importance of technology in learning mathematics, technology affects the mathematics taught and improves student learning.

The development and optimization of technology is one of the goals of education according to Anikina and Yakimenko (2015). Mathematics education is currently developing due to technological developments. Applications and games can be found today which aim to help and facilitate students in understanding mathematical concepts (Winarko, 2017). Teachers need to take advantage of technological developments to assist in the learning process.

One way to take advantage of technological developments to improve mathematics learning is to use game-based learning media. Game-based learning media is one of the media that combines elements of education with games or games. Games in game-based learning media have the potential to strengthen students' learning memory and thereby increase learning success (Staalduinen, 2012).

Mathematics learning outcomes are one component that can be improved through the use of game-based learning media. Learning outcomes are abilities obtained by students after participating in the learning process (Abdurahman, 2003). It is important for teachers to prepare effective learning so that the learning outcomes obtained by students can be maximized. One of them is by paying attention to the learning media used in the learning process.

In addition to learning media, the methods used in learning are also important. The drill method is one method that teachers can use to help students learn. The drill method can be interpreted as a way for teachers to teach where students carry out various activities in the form of exercises, so that students have higher skills than the material that has been studied (Roestiyah, 2012). This method can be combined with learning media in learning mathematics.

Several previous studies showed that game-based learning media showed a positive relationship to student learning outcomes. Research

conducted by Kebritchi, Hirumi, and Bai (2010) found that there was a significant increase in students' mathematical achievement for the experimental class using game-based learning media. In addition, Chen and Ren (2013) revealed that students' ability to understand the concept of prime numbers increased through the use of role play games in learning. Pareto, Arvemo, Dahl, Haake, and Gulz (2011) also conducted research which revealed that learning media in the form of arithmetic educational games could improve students' conceptual understanding of mathematics.

In addition to game-based learning media, the application of the drill method also shows that it can improve students' mathematics learning outcomes. Research conducted by Juniati (2017) revealed that there was an increase in students' math scores through the application of the drill method. Furthermore, Panggabean and Sumardi (2018) revealed that there was an effect of the drill method on students' mathematics learning outcomes in the factorization of algebraic terms.

Based on some of the descriptions above, it can be said that the potential use of technology, especially game-based learning media, can help students' mathematics learning process. Through the media developed, namely, Count-IT! Game on the number material is expected to improve students' mathematics learning outcomes.

Metode Penelitian

This study aims to describe the preliminary analysis on the development of game media and see the student's preliminary response to the developed game-based mathematics learning media that is oriented to the learning outcomes of junior high school students. Media development is carried out based on the ADDIE development model. The ADDIE development model consists of 5 stages (Branch, 2009). The following is an explanation of the ADDIE development model procedure.

- 1) Analysis; The analysis stage is an activity to determine the objectives of product development in the form of learning media. The analysis carried out included problem analysis, curriculum analysis, analysis of student

characteristics, and analysis of the required resources. Researchers also need to analyze the feasibility and requirements for developing learning media.

- 2) Design; The design stage is to design learning media to be developed, collect materials to be used, and develop research instruments. In addition, at this stage the researcher also sets learning objectives and designs learning activities.
- 3) Development; The development stage includes development activities based on the designs that have been carried out. In addition, at this stage validation and revision of learning media are carried out to achieve the expected goals. After the development stage is carried out, the research can be continued with the implementation of learning media in the field.
- 4) Implementation; The implementation stage is the realization step of the learning media that has been made. The realization step is often associated with field trials. After the implementation is carried out in the field, an evaluation is carried out.
- 5) Evaluation; The evaluation stage can be defined as a process carried out to provide value to the learning media (revision). Revisions are made based on the results of product evaluations. Basically, evaluation can be done on the implementation of the five steps in ADDIE.



Figure 1. Development Model Procedure

The respondents in this study were junior high school students totaling 122 people. Students are given a questionnaire related to game development. The questionnaire consists of 5 closed statement questions, with 4 answers on a Likert scale, namely strongly agree, agree, disagree, strongly disagree. Quantitative data obtained through questionnaires were then processed using MS Excel. The statements in the questionnaire are as follows:

- 1) Game learning media is needed in number topic.
- 2) Game learning media that can be played on mobile phones will make students easier to learn.
- 3) The display of the game media is attractive.
- 4) The color combination in the game media is interesting.
- 5) The characters in the game media are interesting.

Result and Discussion

The research resulted in an initial product in the form of a game learning media called Count-IT!. First, analysis and design development are carried out based on the ADDIE development model stage. The explanation of the three stages is as follows.

Analysis Stage

1. Curriculum Analysis

The curriculum used as the basis for developing game learning media is the 2013 curriculum at the junior high school level, because the media was developed to facilitate junior high school students. Then, one of the scopes of mathematics material for SMP/MTs in accordance with the Attachment of the Minister of Education and Culture Number 24 of 2016 is numbers. The learning method used in Count-IT! Game namely the drill method and the learning material presented is numbers. The following are core competencies and basic competencies in the number material in Table 1.

Table 1. Core Competencies and Basic Competencies in Class VII Junior High School Numbers

Core Competencies	Basic Competencies
Understanding knowledge (factual, conceptual, and procedural) based on his curiosity about science, technology, art, culture related to visible phenomena and events	<ol style="list-style-type: none"> 1. Explain and determine the order of integers (positive and negative) and fractions (ordinary, mixed, decimal, percent) 2. Explain and perform arithmetic operations on integers and fractions by utilizing various properties of operations 3. Explain and determine the representation of numbers in the form of positive and negative integers
Trying, processing, and presenting in the concrete realm (using, parsing, assembling, modifying, and creating) and abstract realms (writing, reading, counting, drawing, and composing) in accordance with what is learned in school and other sources in the same field. point of view/theory.	<ol style="list-style-type: none"> 1. Solve problems involving the sequence of multiple integers and fractions (ordinary, mixed, decimal, percent) 2. Solve problems related to arithmetic operations with integers and fractions 3. Solve problems involving numbers in the form of positive and negative integers

The material on the topic of numbers is divided into several parts, namely 1) Comparing Integers; 2) Operation of Addition and Subtraction of Integers; 3) Multiplication and Division of Integer Operations; 4) Comparing Fractions; 5) Addition and Subtraction of Fractions; 6) Multiplication and Division of Fractions; 7) Recognize Positive Integers; and 8) Smallest Common Multiple and Largest Common Factor. In the first stage of developing game learning media, Count-IT! version 1.0 specifically for the sub-topics of Comparing Integers and Operations for Adding and Subtracting Integers. Competence and goals to be achieved are one of the aspects that need to be considered in developing game learning media (Charsky, 2010).

2. Analysis of Student or User Characteristics

The game learning media developed is intended for junior high school students, especially class VII SMP. However, this learning media can also be

used by elementary school students, considering that the material for integers and their operations is also taught to sixth grade elementary school students.

Table 2. Characteristics of Students or Users

Characteristics of Students or Users	
Age	≥10 years
Gender	Male/Female
Use for disabilities	Not available

3. Required Resource Analysis

In this study, a learning media in the form of Count-IT! Game was developed which contains the drill method. The material presented in this game is number material. Students or users who take advantage of this game need a smartphone device with the Android operating system to install the game. The use of games on smartphones can benefit users. Besides being able to be used anywhere, one of the advantages of learning through smartphones is that learning activities can occur at any time (Foti & Mendez, 2014).

The results of the questionnaire also show that most students agree that game learning media are needed in number topic and game learning media that can be played on mobile phones will make students easier to learn. The following are data on student answers to statements 1 and 2.

Tabel 3. Statement 1. Game Learning Media is Needed in Number Topic

Answer	Total	Percentage (%)
Strongly Agree	37	30,33
Agree	77	63,11
Disagree	8	6,56
Strongly Disagree	0	0,00

Tabel 4. Statement 2. Game Learning Media That Can Be Played on Mobile Phones Will Make Students Easier to Learn

Answer	Total	Percentage (%)
Strongly Agree	35	28,69
Agree	81	66,39
Disagree	6	4,92
Strongly Disagree	0	0,00

Design Stage

The next ADDIE stage after analyzing is the design phase. At this stage, the researcher designed the game that was developed. There are several things that are done in the game design phase, namely determining the type of game being developed, designing flowcharts, designing storyboards, compiling materials for games, and collecting materials for development.

1. The Type of Game Developed

The type of game developed in this research is RPG (Role Playing Game). Where students can play game characters to solve problems. RPG is one type of game that has a high production value and can attract millions of gamers around the world because of the interaction given to the game (Carbonaro et al, 2006).

2. Flowcharts Design

Flowchart is a flow chart that describes the sequence of work processes of Count-IT! Game developed. The sequence of processes on the flowchart is described in detail from the beginning to the end of the game.

3. Storyboard Design

The game storyboard explains the layout design on the Count-IT! Game media display. Explanation of the display in the form of text, images, animations, audio, background, buttons, navigation, and others. Here is a sample Storyboard Count-IT! Game developed. storyboard design and how to illustrate the game is very important in the game development process. Illustrations in games make students more interested in learning and understanding the material (Setyaningrum & Waryanto, 2017).

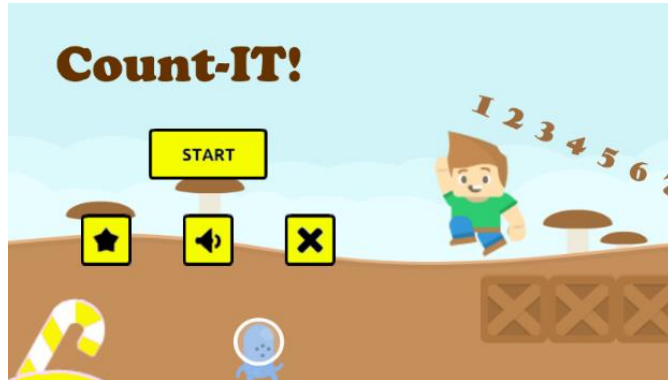


Figure 2. Count-IT! Game Menu Display

The picture above is the design of the menu display in the Count-IT game! developed. On the menu display there are various buttons, namely the *START* button to start the game, the star-shaped button to view game instructions information, the audio button to adjust the volume, and the X button to exit the game.



Figure 3. Count-IT! Game display

The picture above is the design of the display when the game has started. Students will be given problems at the beginning of the game in the form of questions related to integers. Then students through the characters in the game will blow up the box that reads the number according to the solution to the problem given at the beginning. In the game, the characters will be given obstacles in the form of antagonist characters and limited time. Chen and Ren (2013) revealed that challenges in games can provide fun for

students. Giannakos et al. (2012) also revealed that missions in games can stimulate students' interest and motivate students to play math games. This will certainly have a good impact on students' mathematics learning outcomes.

4. Preparing Materials and Collection of Game Media Materials

Materials featured in Count-IT! Game is the number material for class VII SMP with sub topics, namely: 1) Comparing Integers and 2) Operations for Adding and Subtracting Integers. The material presented in the game is based on the 2013 curriculum material. In addition to collecting material, various other materials are also needed to develop the Count-IT! Game media, such as sprites (characters), images, animations, audio, backgrounds, and others. All of these components will also be used as a reference to create a game plot. The plot presented in the game is one of the important components that need to be considered to improve learning outcomes (Lowrie & Jorgensen, 2011).

The results of the questionnaire also show that most students agree that game learning media are the display of the game media is attractive, the color combination in the game media is interesting, and the characters in the game media are interesting. The following are data on student answers to statements 3, 4, and 5.

Tabel 5. Statement 3. The Display of The Game Media is Attractive

Answer	Total	Percentage (%)
Strongly Agree	42	34,43
Agree	76	62,30
Disagree	4	3,28
Strongly Disagree	0	0,00

Tabel 6. Statement 4. The Color Combination in The Game Media is Interesting

Answer	Total	Percentage (%)
Strongly Agree	35	28,69
Agree	79	64,75
Disagree	8	6,56

Strongly Disagree	0	0,00
-------------------	---	------

Tabel 7. Statement 5. The Characters in The Game Media are Interesting

Answer	Total	Percentage (%)
Strongly Agree	34	27,87
Agree	80	65,57
Disagree	7	5,74
Strongly Disagree	1	0,82

Conclusion

Game-based learning media can help students in learning mathematics. This media can help teachers in learning to improve students' mathematics learning outcomes. One of them is on the number topic for class VII junior high school students. In developing the media, it is necessary to do a preliminary analysis first. Then the game design will also determine the success of the learning media. Most students agree that game learning media is needed in number topic, game learning media that can be played on mobile phones will make students easier to learn, the display of the game media is attractive, the color combination in the game media is interesting, and the characters in the game media are interesting.

Daftar Pustaka

- Abdurahman, M. 2003. *Pendidikan bagi anak berkesulitan belajar*. Jakarta: PT Rineka Cipta.
- Anikina, O. V., & Yakimenko, E. V. 2015. Edutainment as a modern technology of education. *Procedia-Social and Behavioral Sciences*, 166, 475-479. <http://doi.org/10.1016/j.sbspro.2014.12.558>
- Branch, R. M. 2009. *Instructional design: the ADDIE approach*. New York, NY: Springer.
- Carbonaro, M., Cutumisu, M., Duff, H., Gillis, S., Onuczko, C., Schaeffer, J., ... & Waugh, K. 2006. Adapting a commercial role-playing game for educational computer game production. *GameOn North America*, 13.

- Charsky, D. 2010. From edutainment to serious games: a change in the use of game characteristics. *Games and Culture*, 5(2), 177-198. <http://doi.org/10.1177/1555412009354727>
- Chen, M. P., & Ren, H. Y. 2013. Designing a RPG game for learning of mathematic concepts. *Second IIAI International Conference on Advanced Applied Informatics*, 217-220. <http://doi.org/10.1109/IIAI-AAI.2013.51>
- Foti, M. K., & Mendez, J. 2014. Mobile learning : how students use mobile devices to support learning. *Journal of Literacy and Technology*, 15(3), 58–78. ISSN: 1535-0975.
- Giannakos, M. N., Choriantopoulos, K., Jaccheri, L., & Chrisochoides, N. 2012. “This game is girly!” Perceived enjoyment and student acceptance of edutainment. *E-Learning and Games for Training, Education, Health and Sports* (pp. 89-98). Springer, Berlin, Heidelberg.
- Juniati, E. 2017. Peningkatan hasil belajar matematika melalui metode drill dan diskusi kelompok pada siswa kelas VI SD. *Jurnal Pendidikan dan Kebudayaan*, 7(3), 283-291.
- Kebritchi, M., Hirumi, A., & Bai, H. 2010. The effects of modern mathematics computer games on mathematics achievement and class motivation. *Elsevier, Computers & Education*, 55, 427-443. <https://doi.org/10.1016/j.compedu.2010.02.007>
- Kemdikbud. 2016. *Peraturan Menteri Pendidikan dan Kebudayaan Nomor 24 Tahun 2016 Tentang Kompetensi Inti dan Kompetensi Dasar Pelajaran pada Kurikulum 2013 pada Pendidikan Dasar dan Pendidikan Menengah*. Jakarta, Indonesia.
- Lowrie, T., & Jorgensen, R. 2011. Gender differences in students' mathematics game playing. *Computers & Education*, 57(4), 2244-2248.
- National Council of Teachers of Mathematics. 2000. *Principles and standards for school mathematics*. Reston, VA: NCTM.
- Panggabean, S., & Sumardi, H. 2018. Pengaruh metode drill terhadap hasil belajar matematika siswa SMP pertiwi medan. *Jurnal MathEducation Nusantara*, 1(1), 89-96.
- Pareto, L., Arvemo, T., Dahl, Y., Haake, M., & Gulz, A. 2011. A teachable-agent arithmetic game's effects on mathematics understanding, attitude and self-efficacy. *International Conference on Artificial Intelligence in Education*, Springer, Berlin, Heidelberg, 247-255.
- Roestiyah. 2012. *Strategi belajar mengajar*. Jakarta: PT Rineka Cipta.

- Setyaningrum, W. & Waryanto, N. H. 2017. Media edutainment segi empat berbasis android: apakah membuat belajar matematika lebih menarik? *Jurnal Mercumatika: Jurnal Penelitian Matematika dan Pendidikan Matematika*, 2(1). <https://doi.org/10.26486/jm.v2i2.369>
- Staalduinen, J. P. 2010. *Gamers on games and gaming implications for educational game design*. Delft, Netherlands: Delft University of Technology.
- Winarko, E. 2017. Pembelajaran matematika berbasis TIK untuk meningkatkan literasi matematika: Peluang dan tantangan. *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika*, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.

Nilza Humaira Salsabila

Pendidikan Matematika, FKIP, Universitas Mataram
e-mail: nilza_hs@unram.ac.id

Hapiipi

Pendidikan Matematika, FKIP, Universitas Mataram
e-mail: hapipimath@unram.ac.id

Ulfa Lu'luilmaknun

Pendidikan Matematika, FKIP, Universitas Mataram
e-mail: ulfa_l@unram.ac.id