Android-Based Mathematics Learning Games That are Interesting for Junior High School Students

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Android-Based Mathematics Learning Games That are Interesting for Junior High School Students

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Abstract. The development of information technology is now very fast. Almost all aspects of life are touched by information technology, including games in learning. There are various kinds of games in learning, one of which is an android-based mathematics learning game. This article describes a descriptive research study, which aims to describe how interesting android-based mathematics learning games according to junior high school students. The research subjects were 120 students in grade 7 junior high school. Students were given assignments at home to play Android-based mathematics learning games that have been downloaded through the playstore, then the students were given a questionnaire about mathematics learning games that were interesting for students. The results of the questionnaire were analyzed descriptively then discussed in accordance with the relevant theory.

1. Introduction

It is undeniable fact that technology has revolutionized the way people's life in this modern world, including in teaching and learning process. One of technology devices that in recent years has notably recognized is mobile phone, where it comes in form of smartphone or tablet. Among these, smartphones which based on android and connected to the Internet, are favored by large number of people worldwide, without age consideration or economic background of users. Another important factor is the ability of this devices in resembling computer, where it not only can be used as communication tools, but also it provides software such as scientific calculator, PDF reader, or other counting applications that are helpful for people's activity.

Smartphone, nowadays, has been used for numerous purposes, ranging from business, health and wellbeing, politics, economy, marketing and communication, and education as well. It is important to use the smartphone in positive way since it employ cutting-edge technology which is able to gain and spread information within minutes and in large scale of area. In education field, the use of smartphone can be extremely beneficial, where it can be used as learning media. Gisela et al stated that integrating of mobile devices into education development aims development of networks that include new working and collaborative learning methodologies [1].

One feature of smartphone that attractive for majority of people is availability of games that can be downloaded freely from play store. Copious of games from variety of genre such as sport, adventure, action, simulations, Massively Multiplayer Online (MMO), educational games, and so forth, surely interesting to be played particularly by teenagers since playing game is fun and attractive. Regardless

the large number of android-based games provided in smartphone, there are limited numbers of educational games which actually can be used as effective learning media for pupils.

Digital game these days are played by many people, teenagers and also adults. In school environment, teacher finds a new breed of students of all ages engage in gaming, multitasking and social networking [2]. Camileri also add that today's teenager and adolescent play games on mobile devices including smartphones and tablets [3]. Thus, to make playing game as something with beneficial value, it is considered essential and effective to develop game that can be employed by students in learning activities and the games supposed to be interesting as well. This paper aims to describe how android-based learning games that are interesting for junior high school students be used in learning mathematics. Android is chosen because it has been used widely in Indonesia, including by junior high school students.

Mathematics Android-Based Learning Games

Mathematics is known to be one of the most challenging subjects around the world and myriad of students find it hard to deal with it. Many researchers from different countries have employed several strategies and approach to solve the problems, until the idea of using mobile phone as learning media come into the surface. Visual media can increases students' interests and also enhance students' understanding to mathematical concepts [4]. Besides, research result reported by the Learning and Skills Development Agency (LSDA) from the UK, which stated that in the future many youngsters will use mobile phone not only as communication tools, but also as learning media, specifically in improving their Mathematics and English ability [5]. Introducing games in learning mathematics is believed can bring positive feeling through the lesson, since the use of this media closely related to less anxiety and higher score, as well as the beneficial characteristic that make it valuable learning tools [6] [7]. Thus, the availability of mobile phone which is now commonly known as android-based smartphone make it possible to add games that can be used as media to learn mathematics.

There are several criteria of digital learning games, according to Hense, included the one with android system [8].

1. Defining learning goals and playful elements of the games.
2. Including all learning principles/aspects;
    a. Behavioral aspect; learner/player's actions are completed with feedback, specifically reinforcement; and there are time for exercise and practice.
    b. Cognitive aspect; complex problem that suitable with game context are provided, as well as the information and narrative needed to solve the problems
    c. Constructivist aspect; provide relevant and real problems to players; create social context; provide instructional support; and give opportunities for learners' to construct certain concept.
3. Recall positive emotions
    a. Make sure that learners have fun
    b. Attract curiosity
    c. Nurture feel of satisfaction and pride
4. Motivate positive attitude, by; fostering intrinsic motivation, allowing sense of competence, giving freedom to act by themselves, enabling social relatedness, understanding learner's interests, and enabling flow.

Game that be used in education field or known as educational game is defined by Al-Azawi[9] and Gordon[10] as game being designed and used for teaching and learning, that have fun and educational value, and actively can improve pupils' motivation and engagement in learning process. Chang added that the games can be used by teachers to create a pleasant environment, give sense of victory for students; therefore, changes, challenges and fun can be noticed through entire learning process, and this is the main reason for games appeal to students [11]. In his paper, Randel, Morris, Wetzel and Whitehill (1992) stated that students' internalization in the classroom positively increase when teacher use games with curiosity-causing and challenging aspects [12].

Learning by using game-based learning specifically on smartphone, according to Plass, et al [13] demand games element, such as incentive system, that interesting for students, thus they want to engage with the game, playing and learning as well [13]. Shaffer et al [14] also opine that in solving problems through games and similar experiences in multiple concepts, students are able to connect abstract ideas and real problems, while the process of understanding concept happen. Virtual world of games then can be seen as powerful tool in creating good learning environment to understand certain concept [14] In regards with mathematical learning process, using game will help students in understanding the mathematical concepts easily and in enjoyable way. Therefore, students not only will gain more knowledge, but also the experience about learning environment make the feeling of difficulty in learning mathematics can be alleviated.

This article describes a descriptive research study, which aims to describe how interesting android-based mathematics learning games according to junior high school students. This research is a preliminary research about learning games that are interesting for junior secondary education students. The results of this study will be used for the next research, namely the development of Android-based games for junior high school in learning mathematics. In addition, the results of the study can also be used for researchers who will develop learning games in general.

2. Method

The research subjects were 120 students in grade 7 junior high school. Students were given assignments at home to play Android-based mathematics learning games that have been downloaded through the Play Store. The students were given a questionnaire about an interesting mathematics learning game according to the student.

The questions given to students are as follows:

a. What type of game is interesting for you?
b. What kind of colors in learning games that interest you?
c. Who are the characters in the learning game that you want?
d. How many players in the learning game do you like?
e. Total score in learning games, how much do you think it should be?

The results of the questionnaire were analyzed descriptively then discussed in accordance with the relevant theory.

3. Results

3.1. Interesting type of Game

The results of the study about the types of games that are of interest to students are shown in **Figure 1**. From the picture it can be seen that most students, 78 students (65%) are interested in adventure-type games. 22 students (18%) were interested in acton type games, and 9 students (8%) were interested in games with role playing types. While the remaining 11 students (9%) liked various types of games, including sports, survival, and so on.

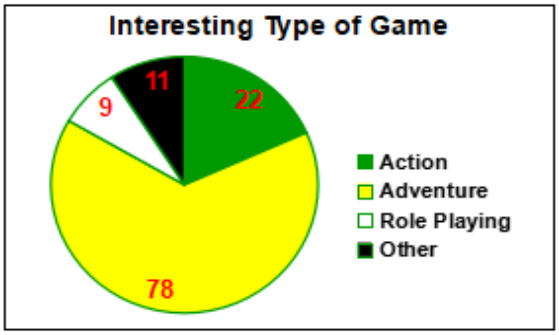

Figure 1. Interesting type of game

3.2. Type of Color in Interesting Learning Games

Color is researched to find out what kinds of colors students like in a learning game. The results of the research are shown in **Figure 2**. From these results showed that 80 students (67%) liked natural colors, 27 students (23%) liked the striking type of color, 8 students (7%) liked gray, while the rest like other types of colors.

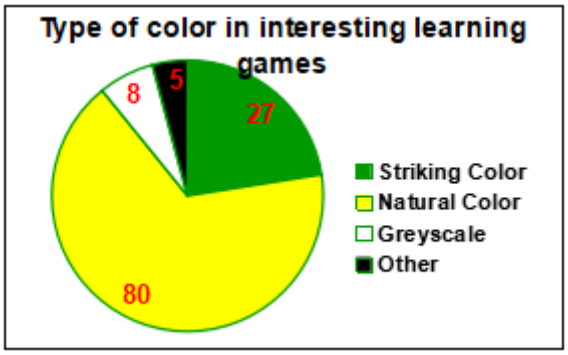

Figure 2. Type of Color in interesting learning games

3.3. Characters in Learning Games

Character is needed to determine the central figure in learning games. With the selection of the most desirable students, the learning media will be more attractive to students. The results of the study can be seen in **Figure 3** which shows that 37 students (31%) liked themselves as the main character, 44 students (37%) liked other people as the main character, 28 students (23%) liked animals as the main character. While the remaining 11 students (9%) liked figures other than those mentioned above.

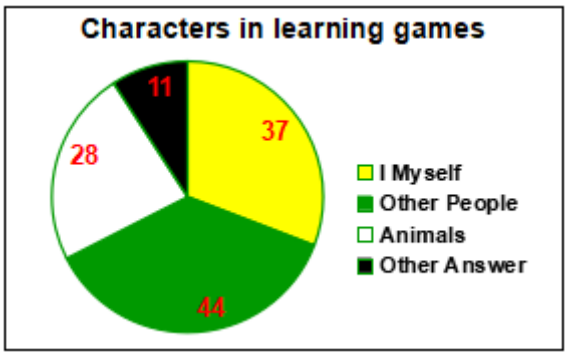

Figure 3. Characters in interesting learning games

3.4. Number of players in learning games

The number of players examined to find out the number of players according to students interesting and liked in a learning game. The results of the study are shown in **Figure 4**. From these results showed that 39 students (33%) liked the presence of two players, 39 students (33%) liked three players, 8 students (7%) liked one player, while the remaining 34 students (28%) likes more than 3 players.

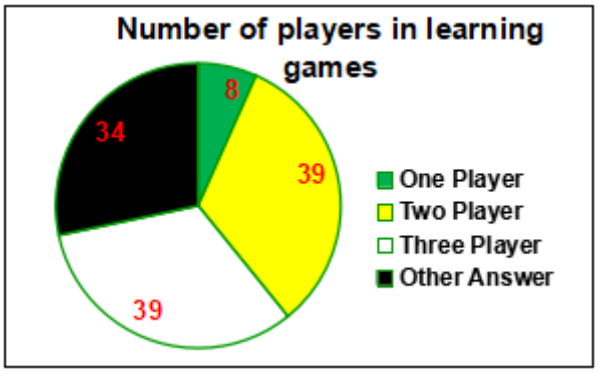

Figure 4. Number of Players in learning games

3.5. Total score in Learning Games

The total score is needed to determine the score that can be obtained by a player in a learning game. By determining the total score that is most desired by students, the learning media will be more attractive to students. From the results of the research presented in **Figure 5** shows that 19 students (16%) liked the total score of 1 to 100, 33 students (28%) liked the total score from 1 to 1000. 40 students (33%) liked the total score of 1 to 10000. While other students as many as 28 students (23%) liked a total score of more than 10000.

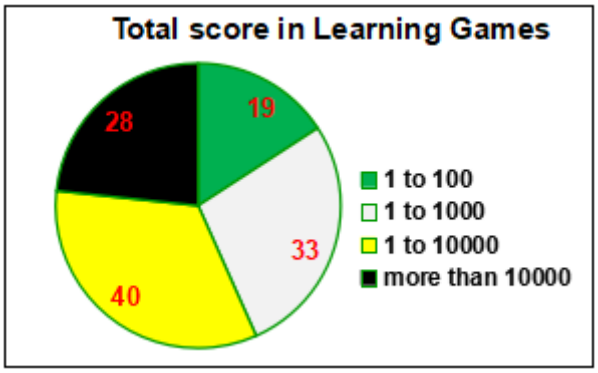

Figure 5. Total Score in learning games

In addition to these results, several results obtained based on input obtained in writing from questionnaires and interviews are there are some students who like sports-type games, funny games and survival games. However, in general students like games with many challenges, such as those found in adventure-type games.

4. Discussion

From this results it is known that students prefer the type of adventure game. This is in accordance with the age of students in the range of 12 to 14 years. According to Piaget's theory of development, this age includes formal operations. This can be used as a consideration for making adventure-type learning games and can be directed to more formal operations. Various kinds of math learning games can be made adventure models. Examples of math learning games with adventure type are adventures that combine natural situations that are challenging with concepts in mathematics, such as the concept of slope (gradient), number concept, building space and so on. Learning mathematics thorough android-based games can help students including junior high school students in learning process. Elkind stated

that students can get social, emotional, and intellectual skills when learning through games, since through the process they can create new learning experiences [15].

The findings in this study are also in accordance with the results of Lowrie & Jorgensen's study [16]. In their research, They used an adventure game that was well-acknowledged by survey participants, namely "The Legend of Zelda : Phantom Hourglass" [16]. This game challenged players to locate a lost person by navigate different virtual environment. Like majority of games that using level-based mode, this game adapted same method, thus the player have to complete a certain stage before moving to the higher one. The game was selected due to its hand-held consoles, therefore it can be played in various context and settings, and more importantly it was in line with curriculum based mathematics ideas (e.g., problem solving, two-and-three dimensional space, and position) [17].

In terms of players' number in learning through games, students have tendency to be in game with more than 1 player. This can be used by teachers to design learning in groups by utilizing mobile-based games. The number of group members can be 2, 3 or 4 according to the characteristics of the mathematics material. This is in accordance with social constructivism developed by Vygotsky. Plowman, McPake, and Stephen (2010) stated that digital game can promote collaboration, problem solving and communication, experimentation and exploration of identities [3]. In their age, Sardone stated that when students were asked about the value of gaming technologies related to learning, 51% of them grades 6-12 noted that games make it easier to understand difficult concepts ; 50% stated they are more engaged with the subject; and 44% argued that solving problems were more interesting when they playing games while learning [18]. Lenhart et al (2008) also provided research finding of the Pew Internet & American Life Project that indicated that media such as computers, the web, consoled, and handheld devices like smartphone, are used by 97% of youngsters aged 12-17 for playing digital/video games [19].

It can be concluded that playing games is attractive for majority of teenagers, thus developing mobile games that can help them learning mathematic will increase their understanding and also create comfortable environment for learning.

From the study it was also found that students like natural colors in learning games and a high total score. Natural colors will make students' attention not split and can reduce cognitive load so that students can concentrate on playing games. A high total score (more than 100) gives a long score range, so students are more motivated to get a higher score. By getting a high score students will feel more satisfied and increase their confidence.

5. Conclusions

To make good math learning game, it is important to consider types of games that are interesting for students so they want to run it. Through interesting learning games, it is expected that mathematics learning will be preferred by students.

Game with adventure type is the type of game that is most liked by students. In adventure type games there are many challenges with various situations, this makes students like the game. In addition students are also happy with learning games with natural colors that are not flashy, the number of players is more than 1 player. People in learning games can use themselves players, other people or animals. While the total score used in the learning game, the higher the total score used, students are more like.

References

[1] Gisela T.de Clunie; Clifton C.T.; Aris, C; Norman, R. 2013 Android Based Mobile Environment For Moodle Users. *International Conference Mobile Learning 2013*, ISBN:978-972-8939-81-6.

[2] Jenkins, H., Clinton, K., Purushotoma, R., Robinson, A. J., & Weigel, M. 2006 *Confronting the Challenges of Participatory Culture; Media Education For the 21st Century*. Chicago: The MacAurthur Foundation.

[3] Camilleri, M.A. & Camilleri, A. 2017 The Students' Perceptions of Digital Game-Based Learning. In Pivec, M. (Ed.) 11th European Conference on Games Based Learning (October).

Proceedings. H JOANNEUM University of Applied Science, Graz, Austria.

[4] Ogochuwku, N. 2010 Enhancing students interest in mathematics via multimedia presentation. *African Journal of Mathematics and Computer Science Research* Vol. 3(7), pp. 107-113, July 2010 Available online at http://www.academicjournals.org/AJMCSR; ISSN 2006-9731

[5] Kachepa,A & Jere, N. 2014 Implementation Of Mobile Games For Mathematics Learning: A Case Of Namibian Schools. *International Journal of Scientific Knowledge*, Vol. 5, No.5 ISSN 2305-1493

[6] Hambree. R. 1990 The Nature, Effects, And Relief Of Mathematics Anxiety. *Journal for Research in Mathematics Education*, Vol. 21, No.1, 33-4. Adrian College

[7] Aikaterini Katmada, Apostolos Mavridis and Thrasyvoulos Tsiatsos 2014 Implementing a Game for Supporting Learning in Mathematicss. *The Electronic Journal of e-Learning* Vol 12 Issue 3, pp 230-242

[8] Hanse, J and Mandl, H. 2012 Learning In or With Games? Quality Criteria for Digital Learning Games from The Perspective of Learning, Emotion, and Motivation Theory. *IADIS International Conference On Cognition and Exploratory Learning in Digital Age (CELDA 2012)*, ISBN : 978-989-8533-12-8.

[9] Al-Azawi, R; Al-Faliti, Fatma; Al-Blushi, Mazin. 2016 Educational Gamification Vs. Game Based Learning: Comparative Study. *International Journal of Innovation, Management and Technology*, Vol. 7, No. 4, August 2016

[10] Gordon, C. 2016 Enhancing learning and social adeptness through games in the EFL classroom. *Journal of Research and Pedagogy*, Vol. 2, pp 95-120.

[11] Y. C. Chang , H. Y. Peng & H. C. Chao 2010 Examining the effects of learning motivation and of course design in an instructional simulation game, *Interactive Learning Environments*, 18(4), pp 319-339, DOI: 10.1080/10494820802574270

[12] Randel, J.M., Morris, B.A., Wetzel, C.D., & Whitehill, B.V. 1992 The effectiveness of games for educational purpose: A review of recent research. *Simulation and Gaming*, 23(3), pp 261–275.

[13] Plass. J, Homer B, Kinzer, C. 2015 Foundations of Game-Based Learning. *Educational Psychologist*, 50(4), pp 258–283, ISSN: 0046-1520 print / 1532-6985 online, DOI: 10.1080/00461520.2015.1122533

[14] Shaffer D, Squire K, Halverson R, and Gee J. 2005. Video Games and the Future of Learning. *Phi Delta Kappan*, Vol. 87, No. 02 (October 2005): pp. 104-111.

[15] Elkind. 2008. The Power of Play; Learning that Comes Naturally. *American Journal of Plays.* Board of Trustees of the University of Illinois

[16] Lowrie, T., & Jorgensen, R. 2011 Gender differences in students' mathematics games playing. *Computers and Education*, 57(4), pp 2244-2248.

[17] Jorgensen (Zevenbergen), R., & Lowrie, T. 2012 Digital Games for Learning Mathematics: Possibilities and Limitations. *Proceedings of the 35th Annual Conference of the Mathematics Education Research Group of Australasia.* Mathematics Education Research Group of Australasia Inc.

[18] Sardone, Nancy, B. & Devlin-Scherer, Roberta. 2009 Teacher Candidates' Views of Digital Games as Learning Devices. Report of Issues in Teacher Education.

[19] Lenhart, A., Kahne, J., Middaugh, E., Macgill, A., Evans, C., & Vitak, J. 2008 *Teens' video games, and civics. Pew Internet & American Life Project.* Retrieved October 6, 2008 from,http://www.pewinternet.org/ pdfs/PIP_Teens_Games_and_Civics_Report. FINAL.pdf

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