**How to Develop Game-Based Edutainment Media**

**to Improve Students’ Interest in Mathematics Learning ?**

**Riska Ayu Ardani1** • **Wahyu Setyaningrum2**

**Abstract**. The affective aspects, interest, can influence the development of student behavior and achievement. Mathematics are abstract and complex can make students’ interest tends to decline. In addition, the technological developments require teachers to understand what the students desire and needs. The purpose of this research is to develop game-based edutainment media that can be used in the learning process of mathematics. This research used ADDIE model to develop media which have 5 stages: analysis, design, development, implementation, and evaluate. Furthermore, media eligibility criteria will be reviewed based on three aspects, validity, practicality, and effectiveness.

**Keywords** Edutainment media• Game •Interest

**Introduction**

Individual motivations such as interest, efficiency, and awareness within students have a major impact on learning behaviors and achievements. Hidi (2006) stated that cognitive ability can develop by involving various neural-emotional circuits that generate unique feelings such as attraction, attention or interest. In fact, during the learning process each student will experience some obstacles such as loss of interest, attention or concentration. These conditions certainly provide a negative influence on the students’ understanding and long-term consequences involving the loss of students’ interest (Fulmer, D'Mello, Strain, & Graesser, 2015).

Increasingly difficult to study math becomes one of the factors that affect the decrease in students’ interest in mathematics learning (Grootenboer & Marshman, 2016). Several studies have identified that in general, students' behavior and interest in mathematics becomes more negative after they have transformed their education from primary school to high school (Grootenboer & Marshman, 2016). It is also conveyed by Sha, Schunn, Bathgate & Ben-Eliyahu (2015) that students’ interest in learning tends to decline as students pass through the transition to secondary school. Consequently, if students have negative feelings such as lack of interest, students will be difficult to engage in learning (Basu & Barton, 2007).

One important aspect of learning process is how teachers can engage students’ interest (Grehl et al., 2017). Given the importance of interest in the learning process, it is necessary for follow-up from the teacher in creating a situation or learning environment in the classroom (Kraft, 2017). There are several factors that need to be considered by the teacher, one of them is the use of learning media. Learning media became a strategic alternative as a means of supporting students to learn mathematics independently. Learning media should have aims and be able to increase the interest of learners. In addition, the media should encourage students to understand what is learned. The results of Essel, Poku, Menson & Asaew (2016) revealed well-designed media will provide an alternative to acquire active learning, affective aspects and students' self-understanding.

Teachers need to consider the use of technology in developing learning media. It is necessary for teachers to follow the transformation of teaching and learning process in this modern era (Xu & Jang, 2017). However, the use of technology must be done in an integrated and inclusive manner in the process of use, consumption and interaction (Anikina & Yakimenko, 2015). Currently, students are more demanding and know what they want and like. While the teacher should always be vigilant and continue to interact to motivate students every day. Therefore, very important for teachers to understand the role of technology in society today, including its impact on teaching and learning process. Technology can contribute to change the paradigm of learning and teaching at this time so that students leave their passive position to be active agents in their own learning (Heugl, 2004).

Technology is growing rapidly in various fields, including education. Nevertheless, the learning media to meet the needs of students is still limited and need to continue to be modified by utilizing technological sophistication. Classroom learning media so far are available in several types such as visual aids, interactive media, print media, audio-visual media and edutainment media. Learning media required by students is an interesting, effective and efficient media. In addition, the media used to support students learn independently. This is supported by the results of Ardani, Handican, Salsabila & Setyaningrum (2017) research indicating that 97.31% of 217 junior high school students with different characteristics stated that they needed edutainment media in the learning process. Learning media such as edutainment have high potential that can overcome boredom and attract students to learn (Burril, Allison, Breaux, Kastberg, Leatham & Sanchez, 2002; Olive et al., 2010).

**Theoretical background**

**Edutainment Media**

Edutainment media is one of the learning media that combines educational and entertainment content that can be used to facilitate the learning process (Singhal & Rogers, 2001). In addition, Yusof, Daniel, Low & Aziz (2014) defines edutainment derived from a combination of words education and entertainment which refers to the process of learning using technology combined with a subject matter. Anikina & Yakimenko (2015) stated that edutainment media is a medium that applies the technological sophistication with the element of entertainment in the learning process. Overall, it can be concluded that edutainment is a learning process designed on a media so that presented material and entertainment can be combined in a rational and coherent way to achieve the learning objectives. Besides to support students’ learning process, edutainment media can also increase students' motivation and interest through learning process (De Jong, Specht & Koper, 2008).

According to Anikina & Yakimenko (2015) there are several types of entertainment that can be combined in developing edutainment media such as video, movies, music, website, games, and multimedia. Through edutainment students learn to use technology with graphic design so as to convince students that learning is interesting and fun (Okan, 2003). Based on research that has been done Ardani et al. (2017) showed that 65.47% of students choose games as a type of entertainment that can be used in developing edutainment media. Most students have a perception that the use of game-based edutainment media in the learning process can overcome boredom and difficulty learning math. Data are presented in Table 1.

**Table 1** Type of entertainment that students choose to be a medium of learning

|  |  |  |
| --- | --- | --- |
| **which one the type of entertainment is chosen**  **to be inserted in the learning media ?** | | |
| ***Type of Edutainment*** | ***N*** | ***Percentage*** |
| Music | 85 | 38.12 % |
| Video | 98 | 43.95 % |
| Comic | 15 | 6.73 % |
| Game | 146 | 65.47 % |
| Others | 4 | 1.79 % |

In order to develop edutainment media relevant with the purpose of learning, there are some things to note. De Jong et al. (2008) outlined several dimensions to be considered in developing technology-based media.

1. Contents

Content dimensions describe the information that users will get.

1. Contexts

Context dimensions describe context parameters that are taken into account in an effort to support learning processes such as time, place, environment, relationships and number of students.

1. Information Flow

The information flow classifies the media according to the number of entities in the system involved. For example the information flow that can be selected is: one-to-one, one-to-many, many-to-one, or many-to-many.

1. Pedagogical

The pedagogical paradigm can be a learning approach that designs the flow of media.

1. Purpose

The selected goals in developing the media.

In addition, Pakpord & Wannapiroon (2013) revealed that there are 4 elements to consider in developing edutainment media: (a) principles of the instructional model, (b) objective of the model, (c) learning process and (d) measurement and evaluation. Based on the above description, the process of developing edutainment media in this research consider three main things. First, the form of media that includes the type of entertainment, content and content. Secondly, the material delivered through the media includes the approach used. Third, the development of media that needs to be adapted to the development goals. Edutainment media developed in this research focused on edutainment media in the form of game.

**Game**

Learning media such as games can not be easily accepted in the learning process (Bourgonjon, Valcke, Soetaert & Schellens, 2010). The teacher does not have the expert skills in developing game as a learning medium (Bourgonjon, Valcke, Soetaert & Schellens, 2010). In addition, the results of Zin & Zain (2010) showed that in the development of media such as games also required high cost (Zin & Zain, 2010, p.2865). In this case, there was a contradiction between the process of developing game-based edutainment media with high students’ interest in using the media. As an effort to overcome this, then the focus of further research will try to develop game-based edutainment media.

Games presented in accordance with the right instructions will support the learning process and become a better medium than conventional media (Mayer, 2016). In addition, there are several aspects that need to be analyzed: (a) the game used has a target achievement of a competency so that the selected game not only thinks of the students' pleasure in improving the game, (b) presents an increasing level of challenge and maintains motivation or student interest, (c) adapt to the competency level of the student and (d) in accordance with the program and activities to achieve the learning objectives (Mayer, 2016, p.1). The development of increasingly sophisticated technology has an impact on the emergence of various types of games that can be developed as a medium of learning. Cahyo (2011) classified game types into the following categories.

1. Action Game

Types of games involving shooting and fighting activities are therefore more likely to emphasize physical challenges including hand, eye, and reaction time coordination.

1. Adventure Game

The player on this game are assumed to be the main characters who need to complete a particular mission by solving the various puzzles or obstacles encountered in the game plot.

1. Puzzle Game

This game presents a variety of good puzzles that need to be solved directly to reach the next level. This type of game emphasizes the ability of logic, strategy, pattern structure and word completion.

1. RPG

Role play and emphasis on character to flourish, changing to become stronger. This game provides facilities such as weapons, character status, and inventory that can be upgraded.

1. Simulation Game

A type of game that emphasizes simulation games in the game.

Edutainment learning media in this research is an innovation in the field of education that involves the element of the game on the learning process. The type of game chosen on edutainment media development is a type of adventure game.

**Interest in Mathematics**

Hidi revealed that "[s]tudents’ interest plays a crucial role in predicting students' persistence at learning" (Hidi, 1990, p.567). Cheng & Wang (2017) revealed that interest is the best motivator for children and adolescents to do physical activity. Interest not only affects the student's learning achievement, but also influences students' attitudes and choices in making decisions about what is liked and learned (Beggs, Bantham, & Taylor, 2008). Furthermore, Nitko, Rotgans, Jerome & Schimdt (2017) also stated that interest in learning in the individual is a form of desire to relate to learning activities. Based on several opinions about the interest, it can be concluded that interest is a factor in the individual that affects the individual to perform certain activities.

In the context of education, interest can be divided into three forms (Ainley, 2011). First, interest is the level that describes the psychological stage of a situation. Second, interest is the response that occurs to a particular situation and indicates a form of attention is as a personal orientation, a relatively stable tendency to engage in a particular domain.

According to Carmichael (2017) interest is considered an important construct of motivation in learning mathematics. This is because interest built by two control systems are emotional and cognitive (Carmichael, 2017). Interest in learning mathematics includes influences related to students’ knowledge and activities because of the emotional, value, and cognitive dimensions (Krap, 2007). Students' interest in mathematics is related to the number of completed tasks, task orientation and student skills, student personalities, the quality of mathematics teachers, facilities and teaching materials in the learning process of mathematics (Odogwu, 1994). Based on some of these opinions, it can be concluded when students have an interest in mathematics, then students will experience emotions such as fun and interest when participating in the learning process of mathematics. Overall interest in mathematics can be reviewed from the following indicators.

1. Curiosity about mathematical objects.
2. Interest to engage in the learning process and solve mathematical problems.
3. Shows attention to the continuity of the learning process of mathematics.
4. Confidence to be able to achieve learning objectives and solve problems.

**Research questions**

After investigating the students’ needs on the media used in the mathematics learning process (Ardani et al., 2017) and the importance of students’ interest in achieving learning achievements (Carmichel 2017; Cheng & Wang, 2017; Hidi, 1990), this research will be focus on development game-based edutainment media. Game-based edutainment media developed refers to a certain criteria and assessment as guidelines for developing quality media. Akker (1999) reviewed product development criteria based on three aspects: validity, practicality and effectiveness. It is also in accordance with the opinion of Nieveen (1999) who review the quality of a product or media based on validity, practicality and effectiveness. In order to get good quality as a medium of learning mathematics, then this study will also answer the following questions.

1. How is the validity of game-based edutainment media?
2. How is the practicality of game-based edutainment media?
3. How is the effectiveness of game-based edutainment media?

**Method**

**Design of study**

The main purpose of this research is to develop software product that is edutainment media in the form of game adventure. Learning media was developed to support student learning activities either on the learning process that takes place in the classroom or used by students independently outside the classroom. The development model used in this research is media development model adapted from ADDIE model (Branch & Kopcha, 2014) with analysis, design, development, implementation and evaluation. The ADDIE development model is chosen because the procedure is systematic and can be used in developing game-based edutainment media.

Yes

No

Analysis

Design

Development

Implementatiom

Evaluation

Revison

Media Tested

**Figure 1** Flowchart of the development stage of game-based edutainment media

**Sample Research**

The test phase in this study was done twice with the number of different test subjects. The first test phase was conducted on a limited scale that involves only 3 students from low, medium and high school grades based on the value of the UN. While the final stage of the trial conducted in large groups involving 30 students from schools that have the category of being. The school was chosen by researchers to represent all cognitive levels of students. At each stage of the test conducted, an evaluation through a media questionnaire to review the quality of the media developed. However, in the final test of the students are also given a questionnaire to see student interest in learning achievement through game-based edutainment learning media.

**Procedure**

Based on the adaptation of ADDIE model, to produce a valid and quality edutainment media, the following procedures should be implemented (Branch & Kopcha, 2014, McGriff, 2000). Analysis phase is needed to find out the fundamental problem needed in developing edutainment media by analyzing the characteristic of student, curriculum, technology and situation. Then we designed edutainment media by creating storyboards, images, sound effects, video, and animation. If all were prepared, the next phase is development. Development is a creation or awakening process that has become a game-based edutainment media. In the implementation phase, the evaluation is conducted to determine the feasibility of the practical aspects. This phase aims to see whether the development of the media succeed and the initial expectations or not.

After the media is developed, the next step is the formative evaluation activities conducted by the researchers themselves (self evaluation). The results of the analysis and revision are then given to experts (expert judgment) either material or media experts to be validated. The results of media validation in the form of data on media quality, media response, criticism and suggestions from material experts and media experts were analyzed to determine the weaknesses and advantages of edutainment media developed. Through the analysis the researcher can determine which parts need to be improved, replaced, and continued. From the analysis results, the researcher need to be revised many aspects in terms of materials, games, and revisions in instructional design before being tested to students.

**Instrument**

To answer the research question, the researcher develops three questionnaires with likert scale. Questionnaires were given to both the expert and the respondent during media trials. Through the questionnaire researchers can review the feasibility of media developed based on valid, practical, and effective criteria.

Learning media is considered valid if it contains material in accordance with the curriculum and is based on the accuracy of such knowledge. The aspects of validity can be seen from the following two things: (a) curricula or learning models developed based on state-of-the art and (b) various components of related learning tools consistently between each other (Nieveen, 1999). Based on the statement, a media can be categorized valid when all components contained in the media must be consistently related to each other.

High quality learning of media were rated by users based on practical value. That is, the media has benefits for users and is practical to use. Bourgonjon, Valcke, Soetaert & Schellens (2010) stated that "[u]sefulness and ease of use, are indeed key determinants to predict mobile game usage and acceptance" (Bourgonjon et al., 2010, p.1146). The statement imply that the usability and ease of the media into a media key developed acceptable.

The third characteristic is that there is consistency between the learning objectives to be achieved with the experience gained through the learning medium. In this aspect the students will be measured ability through non-test instrument to know the interest of learning mathematics students after using game-based edutainment media. Based on the description, it appears that there are three main things that become criteria of decent game-based edutainment media that is validity, practical, and effective. The criteria and assessment aspects in Table 2 are then used to compile the statement items in the questionnaire.

**Table 2** Criteria and quality assessment aspects of game-based edutainment media

|  |  |
| --- | --- |
| **Criteria** | **Aspects** |
| Valid | 1. Content quality. 2. Learning goal. 3. Feedback and adaption. 4. Affective 5. Presentation design 6. Interaction usability 7. Accessibility 8. Usability 9. Standards compliance |
| Practical | 1. *Usefulness* 2. *Ease of use* |
| Effective | Interest in learning mathematics students after using edutainment media on high category can reach |

**Analysis**

The collected data will be analyzed using quantitative descriptive statistical techniques. Quantitative descriptive statistical techniques were used to describe the responses of respondents to the use of game-based edutainment media in terms of valid, practical and effective. Furthermore, from each criterion will be described by some categories.

**Result And Discussion**

**Validation**

**Table 3** Validation Result

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Aspect** | **Score Maks** | **Total Score** | | **Average** |
| **V1** | **V2** |
| Content quality | 10 | 9 | 9 | 9 |
| Learning goal | 15 | 13 | 12 | 12.5 |
| Feedback and adaption | 20 | 18 | 20 | 19 |
| Affective | 15 | 12 | 12 | 12 |
| Presentation design | 60 | 52 | 60 | 56 |
| Interaction Usability | 30 | 24 | 27 | 25.5 |
| Accesbility | 10 | 10 | 8 | 9 |
| Usability | 10 | 8 | 10 | 9 |
| Standards compliance | 5 | 4 | 4 | 4 |
| **Total** | **175** | **150** | **162** | **156** |

**Table 4** Category of Validity

|  |  |
| --- | --- |
| **Score Interval** | **Categories** |
| 147 | Excellent |
|  | Very Good |
|  | Good |
|  | Fair |
|  | Poor |

Based on Table 3, the validation value from two experts is 156. Based on the criteria of validity and the average rating of two media experts (X> 147), based on Table 4 it can be concluded that game-based edutainment media validity is in excellent category. In addition, expert judgements also gave comments and suggestions for improvements that must be made by researcher before the media was tested. Although game-based edutainment media validity is in excellent category, it still has some shortcomings and errors.

V1 stated that “the color of the rectangle and background are not suitable so that the rectangle appears unclear...”

V2 stated that “the mention of some concepts is less consistent and there was a typo in few words”

**Practically**

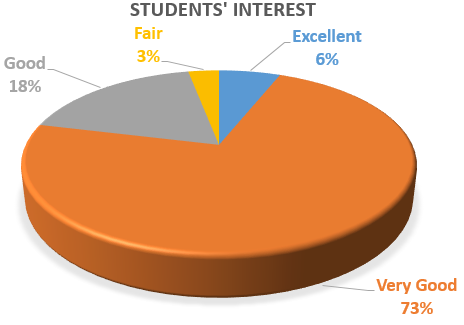
Practical questionnaire consists of 13 statements that review usefulness and ease of use the media. Practical questionnaire is filled by students and teachers after students have finished using the media in mathematics learning process. The results of the practicality assessment by students and teachers are summarized in Table 5.

**Table 5.** Practically Result

|  |  |  |
| --- | --- | --- |
| **Categories** | **Students’ Response** | **Teachers’ Response** |
| **Frequency** | **Frequency** |
| Excellent | 4 | 0 |
| Very Good | 23 | 1 |
| Good | 6 | 0 |
| Fair | 0 | 0 |
| Poor | 0 | 0 |

**Effectiveness**

Evaluation at the final stage is to find out the effectiveness of game-based edutainment media which is oriented towards students' interest in learning mathematics. The interest measured in this study is aimed at reviewing the level of interest in students' mathematics learning which contains 4 indicators, curiosity, attention, involvement and effort. The result showed that 73% student ‘ interest in learning mathematics in the high criteria (very good). Therefore game-based edutainment media can improve students' interest in learning mathematics



**Figure 1.** Effectivenes Result

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