Development of Game Based Learning Biology Course

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ABSTRACT
The purpose of this development is to create of Biology learning media game-based learning product as a medium to help the student grasp concept of waste and recycling waste with game-based learning and build up student attitude to keep environmental care. This research uses the Lee & Owens development method. The development steps are: (1) need assessment; (2) design; (3) development; (4) implementation; and (5) evaluation. The results signified that game-based learning was valid for Biology instructional.

Keywords: game-based learning, biology, waste and waste recycling

1. INTRODUCTION

The environment is everything that is around, both biotic and abiotic components, physical non-physical, including humans with all their behaviour. The amount of environmental damage caused by anthropogenic factors encourages efforts to make environmental improvements [1], [2]. Human activities and behaviour are the main factors causing global environmental damage. The importance of environmental issues began in the 19th century which led to various actions from various countries.

The State of Indonesia has become one of the participating countries paying attention to environmental management efforts [3]. This is proven by the existence of Law Number 32 Year 2009 concerning Environmental Protection and Management whose contents cover planning, utilization, control, maintenance, up to supervision and law enforcement [4].

Waste is material that is wasted or disposed of as a result of human activities and natural processes that do not yet have economic value [5]. Waste becomes one of the environments closest to daily life if handling is not appropriate, because waste can reduce environmental quality and detrimental to the ecosystem. Broadly speaking, waste can be divided into 3 types: 1) Organic waste; 2) Inorganic Waste; and 3) Hazardous and Toxic (B3) Waste [6]–[8].

Planting care for the environment is very important to be instilled in every student so that all learners are accustomed to taking care of the environment that is the place to study. One effort to instil environmental care is through education. The implementation of the 2013 curriculum is the actualization of learning and the formation of student character competencies [1].

The teacher has an obligation to foster and create a variety of activities in accordance with the procedures that have been programmed. Instilling the value of caring for the environment is one example of shaping the character of students. Learning biology is a discipline that examines living organisms. The learning process tends to be memorized because the material in biology learning is in the form of abstract facts and concepts. As a form of teacher efforts in supporting the implementation of the 2013 curriculum, namely the use of various learning methods and media in order to improve learning that follows the latest knowledge developments in students, especially the current generation.

Learners' concern for the environment is not merely the responsibility of the principal but must be supported by the school community[9]. This support can be realized through the process of learning biology. Biology learning directs students to better understand the importance of protecting the environment. In addition, students are trained to be skilled in managing the environment which then becomes a habit in everyday life.

Based on the results of field observations and interviews at the school, most students claimed that they were still confused in distinguishing several types of waste, whether included in the category of organic waste, inorganic waste, or B3 waste [8]. The method of delivering the material that the teacher uses in presenting the waste material is still fixated with lectures, discussions, occasionally the teacher makes use of the learning video. This turns out to make students feel bored, many students feel sleepy one of them because the full day school system that has been applied to the school that makes them prefer to discuss other things.

Besides that, according to the teacher at the school, the attitude of caring for the environment owned by students is also very minimal, visible garbage littered around the trash can area, not infrequently the garbage is put under the table. many trash cans around the school environment are not used properly. Garbage is still visible scattered around the park area, class, in the area around the trash can itself. There are even trash cans that are filled with rubbish with inappropriate types of rubbish. For example, inorganic bins that are supposed to be filled with

dry type garbage are filled with wet, smelly, outdated garbage. If students lack environmental care and allow rubbish to coexist, filtered air will not be healthy for health.

One solution that can be offered is the provision of learning media that can help students to be more enthusiastic in participating in learning, and can foster the character of caring for students' environment. One suitable learning media is game-based learning. Game based learning is a method of utilizing games as a medium that serves to convey learning content, and can be accessed using a mobile device that is a smartphone [10]–[13].

The choice of smartphone is because students at SMAN 1 Boyolangu, Tulungagung, Indonesia, have a mobile device or smartphone in person. Most students use smartphones to access social media, play games and are used to browse schoolwork. So, it is unfortunate if the use of mobile devices or smartphones that are high enough is not directed to learning. According to Suharsimi [14] learning media is an integral part of the learning system, so that the media used in learning must follow the advances in technology and information, so students can have skills in their day.

The purpose of the media is designed is to facilitate learning activities, both teachers and students. The use of games has proven to be effective in transferring factual knowledge like learning through textbooks. Proven, various digital educational game applications have brought a pleasant learning environment, motivating, increasing creativity, stimulating emotional development and developing children's psychomotor [10] Based on the above review, the development of game based learning has advantages compared to other learning media.

2. METHOD

The development of game-based learning by researchers uses the Lee & Owens development model which has the following steps: (1) analysis; (2) design; (3) development; (4) implementation; and (5) evaluation [15]. The analysis phase is the initial stage of the study. In the analysis phase, it is divided into two stages, namely needs analysis and front-end analysis. The analysis was done by observation and interviews with the teacher and class X students at the school.

In the need's analysis phase (need assessment) shows that students already have the initial ability to waste material and waste recycling, because they have learned it at the previous level of education. However, their understanding is only limited by printed books, joint discussions in class without illustrations that can attract students' attention.

Meanwhile, in front-end analysis is used to bridge the gap between determining the solution what is needed, where there are 10 ways that can be used, namely: (1) audience analysis; (2) technology analysis; (3) situation analysis; (4) task analysis; (5) analysis of issues; (6) analysis of significant events; (7) analysis of objectives; (8) media analysis; (9) data analysis; and (10) cost analysis.

The next step is design, at this stage the planning stage of a learning media, planning is a very important part of achieving success in developing learning media. Design analysis includes: (1) making storyboards; (2) design a schedule of activities; (3) define the development team; (4) designing media specifications that are divided into 2, namely: (a) physical specifications include the results of the development (output) later in the form of APK; and (b) content specifications include parts contained in the application such as the operating system used, navigation buttons, images, sounds, and the game itself; (5) structure of the content contained in the game and; and (6) configuration control as the final step in developing a product.

Development is the third step (3) of this development model, at this stage it is a step that will realize everything that is designed in the design stage such as making media and giving material in the media. The next step, Implementation is the application of game-based learning. The purpose of implementation is to collect data from the audience as a basis for determining the feasibility of the product so that it is able to meet the objectives in learning.

The final step is Evaluation, at the evaluation stage there are several points that must be considered, among others: (1) evaluation objectives which aim to determine the feasibility of the media being developed, at this stage giving questionnaires / instruments to media experts, material experts and audiences; (2) evaluation strategy includes determining measurement tools in the form of tests, and grouping the types of data obtained such as qualitative and quantitative data; (3) evaluation plan includes filling out the problem statement, filling in the solution, filling in the objectives, completing the summary; (4) validity measurement consists of two stages, namely determining the level and type of validity, and determining the validation of research instruments; (5) development of instruments aimed at increasing the effectiveness of the activities carried out, questionnaires and tests are developed in accordance with the evaluation strategy, evaluation plan, as well as the type, and level of validity; and (6) data collection analysis is a data collection technique that is carried out through instruments and given to media experts, material experts, and audiences.

The product trial in the development uses the instrument as a data collection technique and is given to three respondents namely a media expert to assess the quality of the media, 2 material experts to evaluate the media about the material displayed on the learning media, and 32 audiences as media evaluators and the researcher will find out whether or not a learning media has been developed. The data obtained in this development uses two data, qualitative and quantitative. Qualitative data were obtained from the responses of media experts, material experts and audiences. Meanwhile, quantitative data were obtained through questionnaire scores from media experts, material experts and audiences. In collecting data for questionnaire data analysis using percentage. By looking at the following validity levels (Table 1).

$$P = \frac{\sum x}{\sum y} x\ 100\%$$ [16]

Explanation:
P = Percentage
X = Number of answers to all respondents
Xi = The ideal number of scores in one item

Table 1 Validity Levels

Category	%	Score	Note
A	76-100	4	Valid
B	51-75	3	Enough Valid
C	26-50	2	Less Valid
D	0-25	1	Invalid

3. RESULTS AND DISCUSSION

The validation of the development of game-based learning is done to media experts as media evaluators who have been developed. Material experts as assessors of material contained in media that have been developed, as well as students as subjects of product trials. The results of the analysis of media expert data on game-based learning media is 97.5% where the results fall into the percentage of 76-100% category A which means the media is valid and feasible.

The results of the analysis of material expert data on the material contained in the game-based learning media is 96.87% where the results are included in the percentage of 76-100% category A which means the media is valid and feasible. The results of the analysis of individual trial data consisting of 3 students of game-based learning media were 86.67% where the results were included in the percentage of 76-100% category A which means the media was valid and feasible.

The results of the analysis of small group trial data consisting of 6 students of game-based learning media were 86.45% where the results were included in the percentage of 76-100% category A which meant the media was valid and feasible. The results of the analysis of the large group trial data which included all students of class X MIPA 2 who were the subjects of the trial were 87.40% where the results were included in the percentage of 76-100% category A which meant the media was valid and feasible.

4. CONCLUSION

Based on trials that have been carried out the development of game-based learning can be said to be valid, as evidenced by the results of trials of media experts, material experts and audiences showing the results of valid analysis and the process of using game media runs well. Suggestions for use are obtained so that the game application can be used as a learning medium that helps teachers create a more enjoyable teaching and learning process. Also, it can be used independently by students, not dependent on school hours so students can be more absorbed in learning.

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