Development of mathematics interactive learning media with gamification concept for mentally disabled students

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Abstract. Conventional media and the limitations of mentally retarded students in understanding abstract concepts have made it difficult for teachers to deliver learning material. It is indicated that there is a need for interactive media, especially in mathematics with the concept of Gamification. Thus, this study aimed to develop interactive learning media with the concept of Gamification to increase concentration and learning interest of mentally retarded students, and to know students' responses to the media developed. This study was a research and development study which data collection was done using instruments. The subjects of this study were mentally retarded students in the D2 class of SLB Negeri 2 Buleleng. The data were analyzed using descriptive analysis techniques. The results showed that the learning media developed was able to become the source and student learning guide. The results of the analysis of student responses toward the development of interactive learning media with the concept of Gamification were 91.1\% included in the Very Good category.

1. Introduction

Education is one of the most important things for children in their daily lives to develop Human Resources (HR). Without education, humans cannot have and keep up with the development of science, technology and art. This is in accordance with Law number 20 year 2003 concerning the National Education System (Sindiknas) which states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual power, self-control, personality, intelligence, noble character, and skills needed by him, society, nation and state[1].

In the national education system, the implementation of education must be fair and not discriminatory by upholding human rights, religious values, cultural values, and national pluralism. Thus, it appears that all elements of society in the world have the right to obtain education, including children with special needs or often called special children. Through education, children can obtain useful knowledge for themselves, their families, and society.

Children with special needs are children who experience abnormalities in themselves, causing these individuals to have needs that need to be adapted to the specific characteristics they have. [2][3] The disorder is in terms of physical, mental and social behavior characteristics. Children with special needs will certainly face various problems related to their specificity. All these problems need to be solved by providing education, guidance and training services at the level of special school education [4]. One school that organizes education for children with special needs is SLB Negeri 2 Buleleng. This school
is an educational institution that provides educational services for special needs students, one of them is children with mental retardation. Mentally retarded children have the ability to think slow, limited and easy to get distracted so that they are lack of creativity and skills and require a long time compared to normal children in understanding subject matter [5] such as civic education (PKN), science Nature (Science), Cultural Arts Skills (SBK), Indonesian Language and Mathematics. These limitations cause difficulties for teachers in delivering learning material. There are 4 types of mental retardation including the "mild," "moderate," "severe," and "deep" category [6].

One of the limitations was also experienced when teaching mathematics, especially material about knowing how to build space. According to the teacher of the Mathematics Study Program at the D2 class of SLB Negeri 2 Buleleng, mathematics learning includes lessons that are favored by students with material of how to build space using objects that are around the house, school or playground. However, in the delivery of material, it was not supported by the existence of learning support facilities. Thus, students felt bored during the teaching and learning process. This is inseparable from the characteristics of mentally retarded children whose concentration only last up to 15 minutes of class time. Another difficulty faced by teachers was mathematics material that required students to learn abstract structures and patterns of relationships which were not provided by examples of real objects or visualization. These materials are very difficult for students with mental retardation to understand. In addition, teachers also had limitations in developing learning media. Learning process in SLB Negeri 2 Buleleng still used simple visual learning media. This caused difficulties for teachers to increase students' concentration in understanding mathematics learning material.

Based on the results of interviews with teachers in the field of mathematics at SLB Negeri 2 Buleleng, the delivery of material to mentally retarded students with conventional learning media was still ineffective and causing learning saturation. Thus, a learning media that attracts students' attention is needed in order to increase learning motivation and facilities for students to interact with the media. The use of interactive learning media is considered to be better than lecturing and using conventional media because students are more interested in the varied forms of animation, coloring and appearance. Visualization of learning with animation can also increase concentration and focus on children [7].

In this study, the design of interactive learning media was combined with the concept of Gamification, which is the application of game-based design elements and concept in learning using game-principle. The concept of Gamification means applying the game-based concept to the process of teaching and learning activities. Gamification integrates thinking games, game design, and game mechanics with the aim to foster motivation to learn and change student behavior for the better [8][9][10]. The application of the Gamification concept has been carried out for autistic children [11] in helping the therapeutic process. The basic characteristics of the Gamification concept implemented are points, levels, and badges in order to motivate students with autistic disorders. Research which applied the Gamification concept for mentally retarded children has never been done before. Therefore, the researcher intended to apply the concept of Gamification to interactive mathematics learning media for mentally retarded students. The application of the Gamification concept was aimed to give students the opportunity to compete, explore and excel in classrooms and to create a more enjoyable learning atmosphere. In addition, the concept of Gamification also provides convenience for teachers in evaluating their students through quiz menus that are packaged in the form of games at the end of the material and rewards for students who answer correctly and enthusiastically[12].

Based on the description before, the researcher intended to conduct a research entitled "Development of Mathematics Interactive Learning Media with Gamification Concept for Mentally Disabled Students".

2. Method
This Interactive Learning Media Development used the MDLC (Multimedia Development Life Cycle) method. There were six stages that must be done. These stages do not have to be sequential in practice. These stages can exchange positions. Even so, the Concept stage must indeed be the first thing to do [13]. The stages of the MDLC method can be seen in Figure 1:
2.1. Concept
The concept stage includes determining the purpose, type, usability, and target of the user in making multimedia applications. The following are the results of the media specifications produced.

a. Learning Media Objectives
   Interactive learning media with Gamification mathematics concept aims to help the learning process and is expected to increase student learning motivation.

b. Learning Material Concepts
   The contents of the learning material design was in accordance to the syllabus of the 2018/2019 academic year. The learning materials that researchers collected were to explain the subject of getting to know space by using objects around the house, school or playground, recognizing the large and small differences in objects based on their size, grouping the building based on certain properties by using objects around the house, school or playground, and sorting objects from small to large or vice versa based on their size.

c. Concept of Learning Media Contents
   The combined concept of interactive learning media with the concept of Gamification consists of introductory, basic competencies / indicators, material, Gamification in quiz form which is inserted at the end of the material and the profile menu.

d. Application of the Gamification Concept
   The characteristics that were used in interactive learning media with Gamification concepts were, such as: points, levels and badges.

2.2. Design
At this stage the researcher used a flowchart to describe the flow from one scene to another and the storyboard to describe the description of each scene.
2.3. Material Collection
During this stage, the researcher conducted the process of collecting materials such as collecting material and questions that would be displayed in Gamification and collecting animations, images, music, buttons, and so on.

2.4. Assembly
At this stage, the process of making learning media was carried out according to the storyboards and flowcharts that had been made before. Broadly speaking, the interactive learning media with the concept of Gamification consists of introduction, basic competencies and indicators, material and Gamification which are presented in quiz form and profile.

2.5. Testing
The testing phase was done after the manufacturing stage and after all data had been entered. First testing was done to determine whether the results were as desired. The testing was done using the Gregory scale calculation [14] as shown in Table 1. For individual tests, small groups and field validations Likert scale was used as shown in Table 2.

Table 1. Level of Assessment Results.

| Achievement Level | Qualification     |
|-------------------|-------------------|
| 0.8 - 1.00        | Very high validity|
| 0.6 - 0.79        | High validity     |
| 0.40 - 0.59       | Moderate validity  |
| 0.20 - 0.39       | Low validity      |

Table 2. Student Response Criteria.

| Level of Achievement | Interpretation |
|----------------------|----------------|
| 0%                   | Very Less      |
| 10 - 33%             | Less           |
| 44% - 66%            | Enough         |
| 67% - 99%            | Agree          |

2.6. Distribution
At this stage, the application was stored in a storage media. If the storage media is not enough to hold the application, compression on the application will be done. This stage can also be called the evaluation stage to develop finished products to make it better.

3. Result and Discussion
In the process of making learning media, the product developed was according to the storyboards and flowcharts that had been made before. Broadly speaking, interactive mathematics learning media with the concept of Gamification consisted of introduction, basic competencies and indicators, material and Gamification which are presented in quiz form and profile. This learning media program used a combination of text, images, animation, and music with interactive navigation buttons to make the program more interactive and interesting. The following are the results of the media that have been developed.
3.1 Media Implementation

a. Initial View of Learning Media
The title page is the start page that will appear when the learning media is opened. The display begins with animated text and animated images. After that, a title page will appear containing the image of the building, the title of the learning media and the entry button. The login button serves to point to the main page of the learning media. The main page of learning media can be seen in Figure 2.

![Figure 2. Initial View of Learning Media.](image)

b. Display of the Main Menu
On the main page of learning media, there is a menu of introductory, basic competency (KD) and indicators, material, quiz and profile. In the upper right corner, there are an exit button to close the media and the volume button to turn off or turn on background. In the header section, the title of the learning media is listed. The main page of the learning media can be seen in Figure 3.

![Figure 3. Display of the Main Menu.](image)

c. Menu Page Display Material
Menu material consists of four main points, namely: recognizing building space, recognizing differences in large and small objects, classifying building spaces, and sorting objects from large to small.

![Figure 4. Menu Page Display Material.](image)

d. Material Build Space
Display of the submenu page “recognizing the building space” as shown in Figure 5.
e. **Quis page view**

Start page quiz menu consists of guessing picture, quiz and answer key. Each page of guessing picture and quiz picture contains 5 questions. If the user's answer is correct or incorrect, there is a true or false notification. At the end of the process, questions will appear as well as badges or digital badges. Students can go to the next question if they can answer correctly. This is the implementation of the level in the learning media. On this page, there is also a retry button to repeat the quiz problem. The initial page view of the quiz can be seen in Figure 6.

![Figure 6. Quis page view.](image)

f. **Display Gamification**

The display for the final quiz page is displayed in Figure 7.

![Figure 7. Display Gamification.](image)

3.2 **Testing Media**

The results of validation from content expert and media test showed the calculated result of 1.00, which refers to the criteria of "Very High". The average calculation of the validity test obtained a result of 1.00, if converted to the criteria table of the average expert test in table 1, it categorized into "Very High" validity level. With the results of this calculation, it can be said that the "learning Valid" concept of interactive Gamification media was appropriate to be used in learning. Data from the product feasibility level test are shown in Table 3.
Table 3. Criteria for Student Response.

| Expert Testing | Calculation Result |
|----------------|--------------------|
| Content        | 1.00               |
| Media Expert   | 1.00               |
| Average        | 1.00               |

The subjects for the individual trials were 3 people with mental retardation in the D2 class of SLB Negeri 2 Buleleng consisting of one person with high learning achievement, one person with moderate learning achievement, and one person with low learning achievement. These students’ learning achievement was obtained from a mathematics teacher. Testing was done through the conduction of the learning process using media guided by the teacher. Students then pay attention to the material explained by the teacher. In this individual trial, students who were involved as respondents answered the questionnaire assessment instrument for interactive learning media products guided by the teacher. The result of individual test is shown in figure 8.

![Figure 8. Graph of Individual Test Results.](image)

Based on individual test response data, the average obtained was 92%. By comparing the percentage data of all subjects, it can be concluded that the Mathematical Interactive Learning Media with the concept of Gamification can be said to be successful or very positive in supporting the learning process of mathematics. The small group test consisted of 6 mentally retarded students. Small group test results can be seen in Figure 9.

![Figure 9. Graph of Small Group Discussion Test Results.](image)

With the average percentage results obtained from the overall subject (92.2%), it can be concluded that mathematics interactive learning media with the concept of Gamification can be said to be successful or very positive in supporting the learning process of mathematics. Furthermore, field trials were conducted with 15 students as the respondents. Each student gave a very good response to the
media developed. A total of 5 students gave good responses. The average of all students was 91.1%. The results of field tests can be seen in Figure 10.

![Graph of Small Group Discussion Test Results.](image)

The development of mathematics interactive learning media with the concept of Gamification for mentally retarded students was intended to improve students’ understanding and concentration of material knowing how to build space and to simplify student learning because the concentration of mentally retarded students only last up to 15 minutes of class time.

4. Conclusion

The development of the design and implementation of the Development of Mathematics Interactive Learning Media with Gamification Concept for Mentally Disabled Students was done through the Multimedia Development Life Cycle method with six stages, namely: Concept, Design, Collecting Materials, Assembly, Testing, and Distribution. The average student response was 91.1%. Learning Media can be a source of learning for students. Learning media are used as students’ learning guides which can increase students’ concentration and focus and further help them learn at school. This is proved by the results of student responses, which were 91.1%, categorized as Very Good. Development of Mathematics Interactive Learning Media with Gamification Concepts was oriented towards SLB Negeri 2 Buleleng as the schools target.

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