Interactive Game: A Step To Reduce Science Learning Difficulties of Elementary School Students

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Abstract— Natural Science is one of the complex materials in elementary school learning. This makes many students experience learning difficulties. Learning media must be able to simplify this complexity, and also reduce the dual perception of abstract concepts by making it concrete. This research aims to develop interactive game media as a medium to reduce students' learning difficulties. This research used the ADDIE model with the steps of analysis, design, development, implementation, and evaluation. The trial subjects were media expert, material expert, learning expert, classroom teacher, and 30 students. Data collection was by questionnaires, interviews, and tests. The data analysis techniques were by content analysis and descriptive statistics. The results of the development of interactive Natural Science game show that the assessment of media expert got a score of 81,25 (very good). Material expert's assessment got 87,5 (very good). Learning expert's assessment got 89,3 (very good). Students' small group trial scored 93 (very good). Teacher's small group trial scored 73,08 (good). Students' large group trial scored 84,66 (very good). Teacher's large group trial scored 84,61 (very good). Therefore, from the results of the research, interactive Natural Science game is feasible to be used by students in the learning process.

Keywords— Interactive Game, Natural Science, learning difficulties

I. INTRODUCTION

Natural Science learning has an important role in achieving educational goals[1]. Through Natural Science learning, students are able to be scientific in solving problems they faced[2]–[4]. Natural Science learning open opportunities to develop students' curiosity naturally by giving them more opportunities to ask questions and find answers based on evidence or facts [5], [6]. Natural Science emphasizes on giving direct learning experiences through the use and development of process skills and scientific attitudes. Therefore, Natural Science has a strategic position in constructing students' knowledge. This position requires Natural Science learning to be delivered by paying attention to the content characteristics and students characteristics. Learning material must be conveyed through interesting methods and interesting learning tools so that learning will be more effective.

Nevertheless, Natural Science learning in elementary schools is still mostly teacher-centered [7], [8]. The results of a preliminary study on 5 elementary schools in Sleman District, Yogyakarta, Indonesia in 2016-2017, found that Natural Science learning was still teacher-centered. Students only listen to the learning material delivered by the teachers.

There were not many learning media that could make students more active in the process of teaching and learning activities in the classroom. In teaching, teachers did not use learning media in delivering the learning materials, thus learning in the classroom not yet maximal. Some schools have computer laboratories for computer course only. Not many have maximized this media for other learning subjects.

Computers are certainly very useful when optimized for the teaching and learning process [9]. Students will get a new atmosphere, thus learning is not just teacher-centered. Computers can be used to develop ICT-based learning media. ICT-based learning media have a significant impact on increasing students' interest and motivation in learning [10], [11] ICT also able to open horizons and present wider knowledge. ICT-based learning media can present very large and very small phenomena that cannot be presented with concrete media. Movements simulations that are too fast or too slow can also be presented clearly. In addition, dangerous objects can also be brought down into the classroom without harm to the students, all through ICT-based media.

One software that can be used by teachers in developing ICT-based media is Microsoft PowerPoint. This software is very easy to be used to create learning media, especially a presentation that attracts students' attention [12]. This is the reason why many teachers use it to teach. However, the features implemented are only limited to presentations. Not many teachers have explored other interesting features to make the media more interactive, one of which is an interactive educational game. Interactive games aim to attract children's learning interest while playing so that they feel happy, then they are expected to be able to easily understand the subject matter presented. Students will be able to solve a problem that is obtained when using learning media in the form of games. Problem-solving is a process in terms of understanding the problem until planning the solution and implementing it [13]. It is expected that students are enthusiastic in finding solutions to the problems they encountered when learning with media in the form of games [13]. Not only happiness while playing games but students also get a different atmosphere when learning Natural Science with games. This is the main background why the game needs to be developed as optimization of PowerPoint software in Natural Science learning at elementary schools. The main objective of this research is to develop an interactive game and implement it in Natural Science learning in elementary school.

II. METHOD

This research was a type of development research with the ADDIE model. The trial subjects from this research were media expert, material expert, learning expert, 10 students for the small group trial, 30 students for the large group trial, and 5th-grade elementary school teacher. This research used descriptive quantitative data. Data were collected by questionnaires to assess the feasibility of the interactive game, tests its impact on students' understanding, and observation to know the impact of the game on learning. The data analysis technique was by quantitative descriptive to determine the feasibility category and descriptive qualitative.

III. FINDING AND DISCUSSION

The steps of this research were adopting the ADDIE model which consists of Analysis, Design, Development, Implementation, and Evaluation.

A. Analysis

The analysis phase produced content, students' characteristics, and media type. In the content analysis, it was found that the highest learning difficulties in the 5th-grade elementary school were in the subject of human motion (skeleton) system. One of the reasons was that the material abstraction was very high. The analysis result of students' characteristics was that they have good technology literacy so that it can be directed to ICT-based learning. In addition, they always wanted to learn with a new atmosphere, because they were easily bored with monotonous things. Analysis of media type was tailored to the needs of the students about ICT-based learning.

B. Design

The software used to design this game was the powerpoint software. The flowchart and storyboard were prepared in advance to put game features before they were developed further. The flowchart is shown in fig. 1.
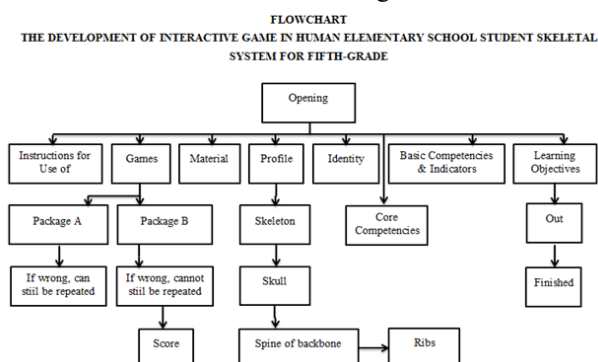

Fig. 1. Flowchart of the interactive Natural Science game

Fig. 1 explains the design of the game as a flowchart. It starts from the opening section namely instruction, games, material, profile, identity, basic competence and indicator, and learning objective. The game consists of two questions and response packages. In the last section, students can see the score and measure learning achievement based on that score. Furthermore, the draft and design of the interactive learning media were developed into interactive game form, then validated by media expert, material expert, and learning expert.

C. Development

At the development phase, the initial design of the game was developed so that it became crucial parts, the results of media development can be seen in fig. 5. This game was produced according to the composition needed, all from the learning material, supporting pictures, learning videos, and questions for evaluation quizzes. At the very beginning of this media, it can be seen as a welcoming note and menu button to introduce the media features (fig. 2).
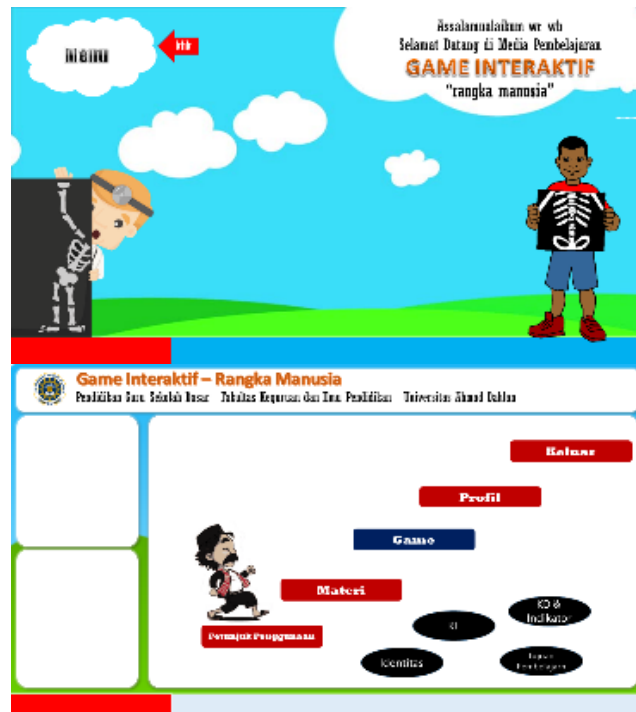

Fig. 2. Display of the opening and media features

Fig. 2 displays the opening section and features of the game. In this section, students must read the instructions first and follow the usage instructions supported. The game is designed so students can learn from the outermost features to evaluation. Furthermore, students must read the instructions guide first before entering other features (fig. 3).
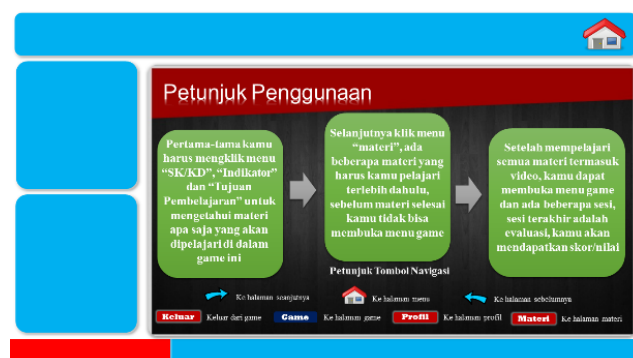

Fig. 3. The menu of the media instructions

In other parts of this media, there is learning material that must be read by students as the main source of information so that students are able to answer all questions from this

game. The display of the learning material was made to be interesting to foster students interest in learning. Presentations of pictures and videos were prepared to clarify abstract concepts. Therefore, they are more easily understood by students and minimize learning difficulties (fig. 4).
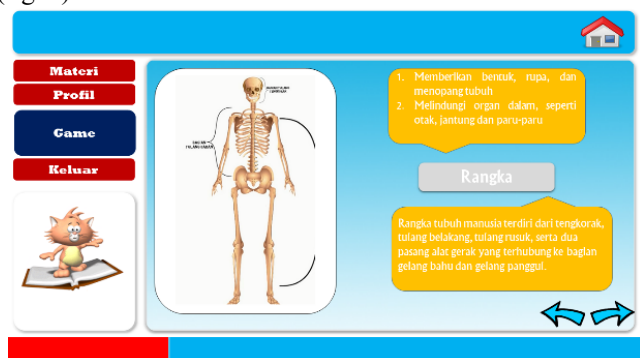

Fig. 4.   The menu of the learning material of human skeleton parts

At the end of this game, there are two different types of games. The first game is the labyrinth, where students run the cursor from the start button to finish not allowed to get out of the path provided. The second part contains 15 quiz questions that must be answered correctly and, in each question, there are deceivers (fig. 5).

Fig. 5.   Labyrinth game and quiz

The results obtained by students from answering questions become an evaluation of students learning outcomes after learning with this game.

The developed game has been through various stages of testing. The trial was conducted on 3 experts, 10 students, and 1 teacher. The results of this trial was a media expert's assessment scored 81,25, material expert scored 87,5, and learning expert scored 89,3. The three assessments lead to a very good category. The results of the trials on students

produced a score of 93 (very good), and trials on the teacher produced a score of 73.08 (good).

D. Implementation

The implementation phase was carried out at the Muhammadiyah Condong Catur Elementary School, Sleman, Yogyakarta, Indonesia by using 30 students in the 5th grade. At this phase, students were given a pretest on the understanding of the concept in writing about the human motion system. Then students were treated with interactive game media. The treatment was given 2 times. Then posttest was given by evaluation questions that were part of the game. The results of the pretest and posttest can be seen in fig. 6.
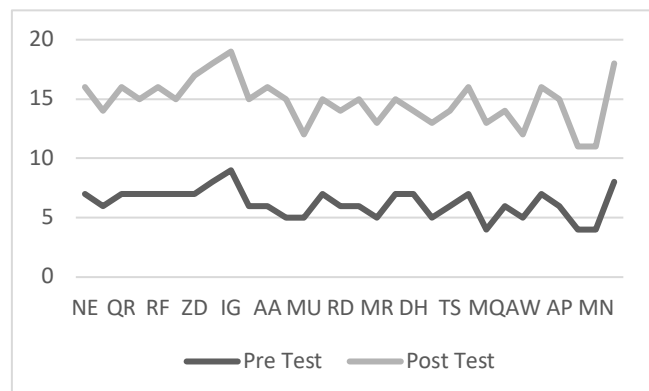

Fig. 6.   Students' Pretest and Posttest scores after the game implementation

At the beginning of the treatment, students' curiosity began to emerge. They looked curious about the media presented. Students asked about the functions of the buttons in the game, asked about its features, and impatient to play it. Students looked enthusiastic and enjoyed learning with the media. They also looked active and did mutual cooperation with their peers. Students were more motivated to learn when using this game because they got a different atmosphere than usual. Students also loved learning with this game because there was part of the game that presented obstacles students must face before they play quizzes. In the learning video section, students paid close attention, so that in the quiz or evaluation section, students could work on the questions smoothly and get maximum results. The posttest results showed an average score of 8,53. This is 36,90 % higher than the score of the pretest. This shows that this game is able to overcome the students learning difficulties.

E. Evaluation

Based on the previous 4 phases, the role of interactive game in learning is significant enough to increase the enthusiasm of students. Students' curiosity arose since the beginning of the implementation of the game. High enthusiasm is related to the achievement of student learning outcomes [13]. Students can be motivated to complete the educational game [14]. They learned and tried to complete this game to be the fastest and got the highest score. This motivation encourages efforts to be the best in the class [15].

This game was designed to focus on developing the students' inquiry so that high curiosity would encourage them to discover new things by exploring all features in the game. The very realistic game content was intentionally

designed to concretize abstract concepts so that each student could get the same perception about the content [16], [17]. This was one of the main considerations that supported the success of the development of this game. When students' perception has been similar, the initial cognitive level has been successfully completed. Then, students can continue the knowledge construction process to the level above it. When this works well, the cognitive aspects of the highest level can be developed.

Educational game help students improve their abilities in designing strategies[18]. This capability also requires good information literacy and digital literacy so that students are able to master the game and solve problems in it. Game help students learned that thinking and communication skills are important in 21st-century learning [19]–[21].

When the educational game is presented in the classroom, students' high enthusiasm appeared. The game made by involving various cognitive students' experiences able to encourage collaborative learning, it also supports the occurrence of meaningful learning [22]. Students' cognitive experience is very important in presenting game-based learning maximally.

IV. CONCLUSION

This research produces the interactive game that suitable to be implemented to the 5th-grade elementary school students based on experts judgment and users response. Experts provided the "very good" assessment, while users (teachers and students) gave the "good" assessment. The implementation of this media in the field has implications for increasing students' understanding of Natural Science concepts. In Qualitative, it also shows the students' involvement in learning and the emergence of high curiosity when students use it. Students' interest in learning Natural Science also increased because of this media.

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