The Development of Digital Comic As Learning Media Based On Picture-And-Picture Learning Model On Global Warming Materials During Distance Learning

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Abstract. Global warming is an environmental physics material that studies the science of rising Earth's temperature, which includes causes, effects and remedies. Digital comics as a learning media are simple media but can involve the material as a whole with interesting delivery. This study aims to develop learning media in the form of digital comics based on picture and picture learning models on global warming materials that are suitable for use during distance learning at the high school level. The method used in this research is Research and Development (R&D) with a 4D research model (define, design, develop, disseminate). The resulting product is in the form of a digital comic that is suitable for use in physics learning during distance learning and tested on 62 students. The feasibility test for learning media on global warming material was validated by media experts, material experts and learning experts using a validation test questionnaire. Then the trial was conducted with a number of students at the high school level. The expected result is that this learning media is feasible and effective for use in physics subjects at the high school level.

1. Introduction

The Ministry of Education and Culture of Indonesia issued Circular Letter Number 15 of 2020 concerning Guidelines for the Implementation of Learning from Home in an Emergency Period for the Spread of COVID-19. In this circular, it is stated that the purpose of implementing learning from home is to ensure the fulfillment of the rights of students to obtain educational services during the COVID-19 emergency, protect education unit residents from the adverse effects of COVID-19, prevent the spread and transmission of COVID-19 in the education unit and ensure the fulfillment of psychosocial support for educators, students and parents. To address this matter. To respond to these instructions, educational institutions in Indonesia from elementary to high school levels have begun to implement distance learning online [1]. Distance learning means the learning process is carried out separately between students and teachers [2]. Although relatively new in Indonesia, according to several studies, online distance learning can be as effective as school-based education. The United States Department of Education analyzed more than 1,000 cases. From this research, it is proven that students who take online classes can outperform students who take offline classes in most subjects [3]. Therefore, online distance learning can be an alternative form of learning during the COVID-19 emergency [4].
One of the learning models that can create an interactive learning process is the picture and picture learning model [5]. The picture and picture learning model rely on images as learning media so that students can remember the subject matter through visual media [6]. Picture and picture learning model is one type of cooperative learning model that uses pictures that are paired or sequenced so that they become a logical picture arrangement [7]. From Serevina and Lulu’s research, virtual media experimentation makes it easier for students to remember and understand the concept of circular motion through illustrated images [8], that means learning with picture media can help students understand the material with a more interesting way. One of the learning media that is suitable for this learning model is digital comic. This is due to the millennial generation’s interest in digital media, which has one function as a tool that makes it easier for someone to access information and entertainment, including stories in the form of digital comics [9].

Basically, comics are usually printed using paper. However, in this modern world, the use of digital comics is becoming more popular. Digital comics are facilitated by devices such as computers, tablets or smartphones [10]. The use of digital comics as a learning medium is expected to be an interesting, creative and innovative learning media that can also make it easier for students to understand the subject matter. The use of online technology can make learning more active, creative and fun as well as cover a wider range of knowledge. The use of digital comics for online learning can improve the quality of the student learning process [11].

The subject chosen is global warming for 11th grade high school science majors. The following is a concept map regarding global warming.

![Concept Map of Global Warming](attachment:image.png)

**Table 1. Global Warming Concept Map**
2. Method

The research method used in this research is research and development methods with a 4D as the model. In the 4D model, there are four stages which include define, design, develop and disseminate [12]. At the define stage, an analysis will be carried out on the needs of students. Furthermore, at the design stage, a design will be made for the learning media under study. Then at the development stage, the learning media will be developed with validation by experts and tested on a limited basis with students and teachers. If the product is feasible and has been tested, the final stage will be carried out which is the disseminate stage where the product will be widely produced.

The data in this study were obtained through the results of validity questionnaires by expert lecturers and trials by educators and students. The data obtained from the test results were conducted on teachers and students by observing the development and using questionnaires. The validation data are divided into three data, namely the validation of the feasibility of the material by the material expert, the validation of the feasibility of the media by the media expert and the validation of the feasibility of learning from the learning expert. While the trial data were obtained from teachers and students, which were then analyzed with a score of 1-5 choices.

| Table 2. Score weight |
|-----------------------|
| Alternative Answer    | Score Weight |
| Totally agree         | 5            |
| Agree                 | 4            |
| Enough                | 3            |
| Disagree              | 2            |
| Strongly disagree     | 1            |

Source: [17]

After that, the percentage of success is calculated using the formula:

\[
\text{Percentage score} = \frac{\text{Total score}}{\text{Max total score}} \times 100\%
\]

The percentage score obtained is then used to measure the quality of the developed learning media. The quality of the media can be known by using the interpretation of scores, namely:

| Table 3. Interpretation of Scores |
|----------------------------------|
| Percentage | Interpretation  |
| 0%-20%     | Very feasible   |
| 21%-40%    | Less feasible   |
| 41%-60%    | Enough          |
| 61%-80%    | Eligible        |
| 81%-100%   | Very eligible   |

Source: [17]

3. Result and Discussion

Based on the steps of the 4D research model, the results of the research in accordance with the research and development procedures are as follows.
3.1 Define

Analysis of the literature and characteristics of students has been carried out with the aim of knowing the needs of students for learning media. Therefore, a needs analysis test was carried out on 62 respondents who were high school students majoring in science. The results of the needs analysis that has been carried out are as follows.

3.1.1 Literature Analysis

Distance learning is a new form of the learning process. Distance learning has the same goals as face-to-face learning with the aim of delivering the same material, but has a different form of presentation where students and teachers do not interact directly. Distance learning is also influenced by information technology, the internet and so on [13]. Based on the results of analytical tests that have been carried out, as many as 62.9% of respondents stated that the models and media used in the distance learning process did not make it easy to learn. Meanwhile, 54.8% of respondents stated that the distance learning that had taken place had not been effective and efficient. Therefore, according to students, an interactive and interesting learning model is needed to be implemented in the distance learning process.

3.1.2 Analysis of Student Characteristics

In school, most teachers allow students to use cell phones because cell phones are considered to make students easier in the learning process so that the learning process becomes more effective. However, in reality, this does not work effectively because students instead use their cell phones to open social media, games or even online stores. For this reason, android-based learning media such as digital comics are needed as a medium for learning physics concepts [14]. Digital comic as learning media can facilitate the learning process, especially to understand physics concepts with examples from everyday life [15]. Based on the analysis test results that have been carried out, 87.1% of respondents stated that they like to solve puzzles in the form of pictures such as puzzles and 80.6% of respondents stated that they were more interested in learning by using picture media. Therefore, the use of image media or visual learning media is very important in the student learning process. While 69.3% of respondents stated that they felt happy and interested in reading digital comics, 46.8% of respondents stated that they read digital comics very often and 37.1% of respondents stated that they read digital comics quite often. While 54.8% of respondents stated that they were interested in learning by using digital comic learning media and another 25.8% stated that they were quite interested in using digital comic learning media. Judging from these responses, it can be concluded that respondents who are high school students are enthusiastic about learning by using digital comic media and support the development of digital comics as learning media.

3.2 Design

At this stage, the design of learning media in the form of digital comics is carried out. There are several stages carried out in the design stage of learning media, including: (1) Determining the subject matter to be developed. In this developmental research, the material that will be used is global warming material, (2) determining the indicators for achieving global warming material, (3) compiling a scenario that will become the main storyline in the comic. The storyline used will be in accordance with global warming material, (4) make rough plans or rough sketches, (5) work on illustrations to realize the rough sketches that have been made and (5) arrange illustrations that have been made in the form of panels into an easy comic to understand. The application used is the Canva.

3.3 Develop

After the product has been designed, the product is developed. Validation is done by experts. If the product is declared unfit for use in the learning process, it will be revised. If the product is valid, a limited trial will be conducted on students and teachers.
3.4 Disseminate

At this stage, the product that has been validated and tested will then be disseminated as a suitable learning medium for distance learning for global warming material.

![Global Warming](image1)

**Figure 1. Cover**

![Table of Content](image2)

**Figure 2. Table of Content**

In the process of learning physics, students as focus or center in the learning process while the teacher is the facilitator. So, it takes learning media that can help teachers convey information [16]. Comic is a visual media, that contains fictional and non-fiction stories which are then presented in the form of images. In this digital era, comics that were originally printed on sheets of paper can now be accessed using digital devices such as smart phones or other devices. Comics are also in demand by children and teenagers because comics can convey information in an interesting, short and easy to understand way. In addition, comics also do not require long sentences to convey information so that comics have a light nature.

Digital comics are not only interesting, but can also be a useful learning media in the learning process. Digital comic as a learning media can increase students' interest in learning, it can also make it easier for students to understand a learning material. In addition, digital comics also have other advantages, such as being able to be accessed easily through digital devices owned by students and can be accessed anywhere and whenever students want without having to face to face in class. This advantage is very suitable for use in the distance learning process due to COVID-19 which is spreading throughout the world.

4. Conclusion

The digital comic learning media based on the picture and picture learning model was developed by research and development using the 4D research method. According to the need analysis, students need interesting media and learning models during the pandemic. In addition, students also stated that they were happy and interested in learning to use digital comic learning media. Preliminary research results show that digital comic learning media is needed by students.

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