Development of the Multiple Representation-based E-book on Physics Subjects in the High School

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Info Artikel	Abstract
	The research was conducted to determine the feasibility of learning media in e-book applications that contain physics learning material for class X. This research was a research and development (R&D) using the ADDIE model. This research was conducted at SMAN 1 Siantan for tenth grade student of class MIA 2, SMAN 1 Palmatak for tenth grade students of class IPA 1, and SMKN 4 Arung Hijau for tenth grade students of class TKJ. Small-scale trials were conducted on students of SMAN 1 Palmatak class X IPA 1 with 15 students. Large-scale trials were conducted on students of SMAN 1 Palmatak class X IPA 1 with 25 students, SMAN 1 Siantan class X MIA 2 with 26 students, and SMKN 4 Arung Hijau class X TKJ with 9 students. Data collection was obtained using a Likert scale questionnaire. The data were quantitative in the form of the percentage of the feasibility of the media developed and qualitative data in the form of comments and suggestions for improvement given by respondents. In the feasibility test by material experts, the percentage is 92.66%. The feasibility test by media experts obtained a percentage of 76.06%. The percentage obtained through small-scale trials is 82.13%. Meanwhile, for large-scale trials, the percentage was 82.26%. It can be concluded that the learning media that has been developed by researchers can be said to be feasible to use.

INTRODUCTION

The development of technology is one of the factors that influence students in learning. Students are in an all-digital generation, where they can quickly obtain information and access anything through digital media (Rostyawati et al., 2021; Roza et al., 2021; Ahmad Syawaludin et al., 2019; Yang & McKenzie, 2018). This is marked by the development of gadgets, and almost all students have gadgets. Currently, the curriculum used in Indonesia is the 2013 Curriculum. In the 2013 curriculum, educators are expected to become facilitators to develop students' knowledge and skills. In addition to educators, students must be active, independent, and think critically during the learning process. One of the sciences that must be studied at the education level is physics. Some students also think that physics has many formulas that are difficult to understand (Huang & Liu, 2017; Martins-Loução et al., 2020; A. Syawaludin et al., 2019; Zulherman, 2018). This happens because each student has different abilities in understanding a material concept. Some students can understand verbally. Some can understand a concept through the images given and various other abilities (Audia et al., 2021; Barenthien et al., 2020; Samuelsson, 2019).

Multiple representations help students learn and build a concept and solve problems, help solve problems (Afriyani et al., 2018; Kusumaningsih et al., 2018; Lu & Hou, 2020). Because students have different bits of intelligence, these multiple representations provide optimal learning opportunities for each student's intelligence because the representations made are different. Explanation of the material can use graphs, pictures, diagrams, sketches, and others. The involvement of learning media during the learning process is expected to affect the learning experienced by students and the goals to be achieved in the learning itself (Ibrahim et al., 2017; Syahri et al., 2021). These facts and circumstances are the basis for

utilizing gadgets as media for learning purposes, considering that media has an essential meaning in the learning process. One that can be used as a learning medium to support the physics learning process is electronic books or e-books that can display subject matter, sample questions, and practice questions, just like printed books. In addition, the e-book can add images and videos in addition to providing explanations to students. Based on the description above, it can be concluded that an e-book based on Multiple Representations is needed for students to support learning, especially in high school physics class X. So that researchers aim to develop an e-book based on multiple representations in high school physics class X.

A. Electronic Book (E-Book)

E-books, usually written as e-books, are translated into electronic books or digital books, unlike books printed on paper or other physical media (Jones et al., 2019; Mahendra et al., 2021; Sultanbekov et al., 2020). E-books have a different appearance from printed books in other physical forms. E-books are read with the help of electronic devices. This is what distinguishes e-books from conventional books.

So it can be concluded that the e-book is a book in electronic form, which no longer needs to use sheets of paper. E-books also contain the same information as contained in books; even e-books have advantages, one of which is that they can include information in the form of videos, which cannot be included in conventional books.

E-books have many advantages when compared to conventional books. E-books are easily accessible anytime and anywhere by their readers because they are digital. If conventional books require a large enough space to store many books, e-book storage will not require ample space. Just provide memory on electronic devices with e-book files that we will store. In addition to having advantages, digital books or e-books also have some disadvantages. Piracy of the work made can be easily hijacked by irresponsible parties. This is due to the ease of access to e-books by anyone. In addition, reduced eye health is also a danger to watch out for if we read e-books too often (Aslam et al., 2020; Kim, 2017). The radiation emitted by electronic devices when we read e-books hurts our eye health.

B. Multiple Representations

Multi representation is a model that represents the same concept in several different formats (Flores et al., 2019; Yilmaz et al., 2018). Some forms of representation in physics can be in the form of words, pictures, diagrams, graphs, computer simulations, mathematical equations, etc. When we want to represent the concepts we teach, we can use several forms of representation, as mentioned by Yilmaz&Flores. According to (Alsalhi, 2020; Yaman, 2020), Multiple Representation is a way of stating or conveying a concept in different ways or modes. The more proficient a person presents a concept in various ways or modes, that person is increasingly mastering the concept (Hestness et al., 2017; Osborne et al., 2016). We will understand a concept that we learn when we can also present the concept in a variety of different ways.

In physics, according to there are several formats of representation that can be raised, namely:
1) Verbal description; to define a concept, 2) Drawings/diagrams; depiction/visualization of a concept to make it clearer, 3) Graphics; long explanation of a concept,4) Mathematics; to solve quantitative problems.
Based on the descriptions mentioned above, it can be concluded that multiple representations are a way that can be used to convey a concept or material in different ways. Submission of a concept or material through several different ways is intended so that students choose what way is easier for them to use to understand the material being taught. There is no one way of representation that is truly optimal for all students because they have different intelligence backgrounds. Therefore, providing various choices of representation is very important to make it easier for them to understand a concept or material being taught.

METHOD

The research method used is the research and development method. According to (Rahayu et al., 2021), "Research and Development was research methods used to produce certain products, and test the effectiveness of these products." The R&D method was when we conduct research that aims to produce a product, and then the resulting product was tested whether it is practical to use. The development model used was the ADDIE development model. According to (Djannah et al., 2021) states that "One model or approach to learning system design that can be implemented to design and develop effective and efficient

training programs is the ADDIE model" (Astuti et al., 2019). The ADDIE learning system design model is simple and can be done gradually or systematically.

The first stage carried out was preliminary research in the form of needs analysis conducted on students. Data from the needs analysis was obtained through a questionnaire filled out by students. The questionnaire contains items of questions asked to find out the students' needs for the media to be developed. The questionnaire provided is also equipped with a suggestion column for researchers.
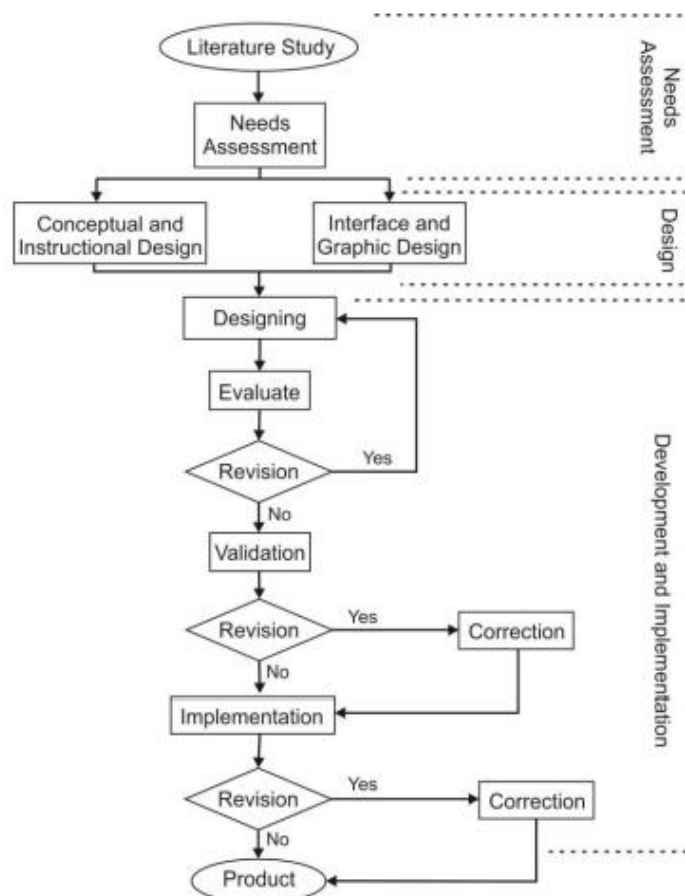

Figure 1. Development Stages

Then the media development plan is carried out in the form of collecting information through library research and needs analysis, then determining the learning materials that will be included in the e-book to be developed, designing the page layout (layout), after designing the design and determining the material, then starting to develop the e-book, then doing feasibility test, and conduct trials.

After the developed media went through several processes, starting from preparation, feasibility test by experts, namely material experts and media experts, small group trials, and large group trials, the media was revised. After the researcher made several revisions based on input and suggestions from the respondents, the media was refined. Media that are considered feasible can be implemented as learning media.

RESULT AND DISCUSSION

Result

An e-book application has been developed in this study that contains physics learning materials for Class X SMA. The learning materials developed are based on Multiple Representations. In the early stages of the research, the researcher conducted a preliminary study in a needs analysis by giving questionnaires to students.

A. Result of Needs Analysis

The needs analysis results show that students need additional learning resources that make it easier for them to study physics material. In developing this e-book application, students need content in

the form of learning materials, sample questions, practice questions, material summaries, and additional images and videos relevant to the material to be included in the e-book application.

The purpose of strengthening in media content aims to make it easier for students to understand the material and also to increase student learning motivation (Zulherman et al., 2021). Innovations such as e-book media have a great impact on student learning outcomes so as to help teachers also in learning (Zulherman, 2018).

B. Developed Media Results

After obtaining data through needs analysis, the next step is to develop learning media.
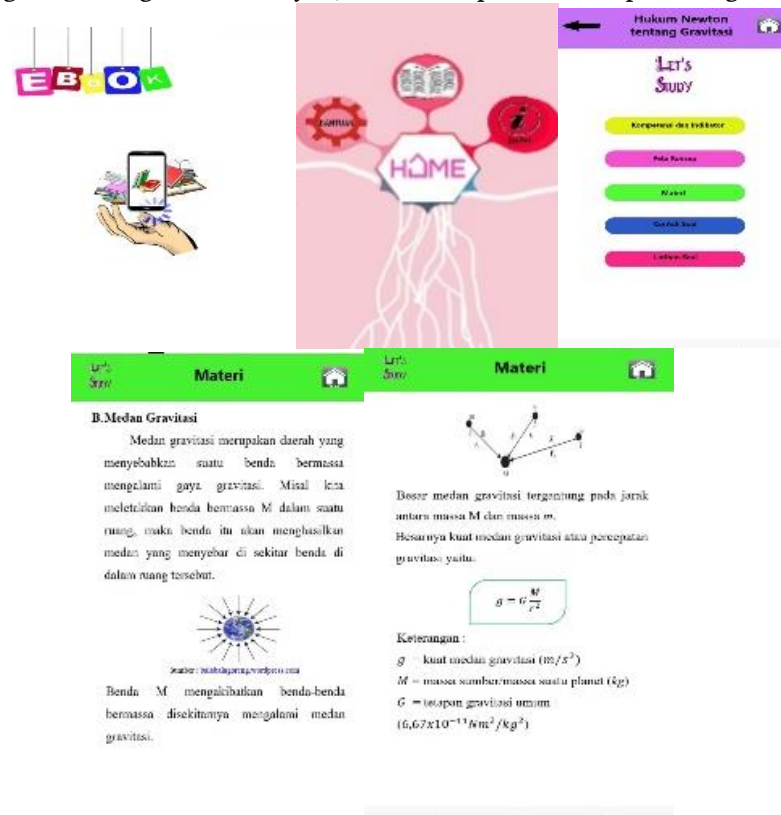
Figure 2. Media of Development

The picture above explains the process of developing the media that has been created, so that the visualization process with this image will help readers understand the e-book media.

C. Feasibility Test Result

Learning media can be said to have been suitable for use in the learning process to test students if they have gone through the feasibility test process by experts. In this study, the feasibility of the media was assessed by four experts, namely two media experts and material experts. The results of the assessment obtained through material experts and media experts are:
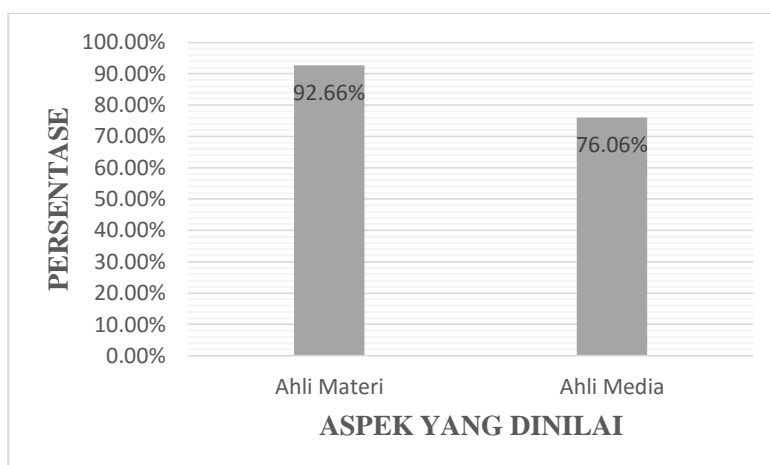
Figure 3. The results of the assessment of media experts and material experts

Assessment by experts shows the percentage of eligibility given by material experts is 92.66% with a very good predicate, and the percentage of eligibility given by media experts is 76.06% with a good predicate. Based on these results, it can be concluded that the learning media developed by the researcher is feasible to use both in terms of material and media.

D. Small-scale and Large-Scale Trial Results

After going through the feasibility test by the experts, the learning media that had been developed by the researchers were tested on students. The following are the results of small-scale trials:
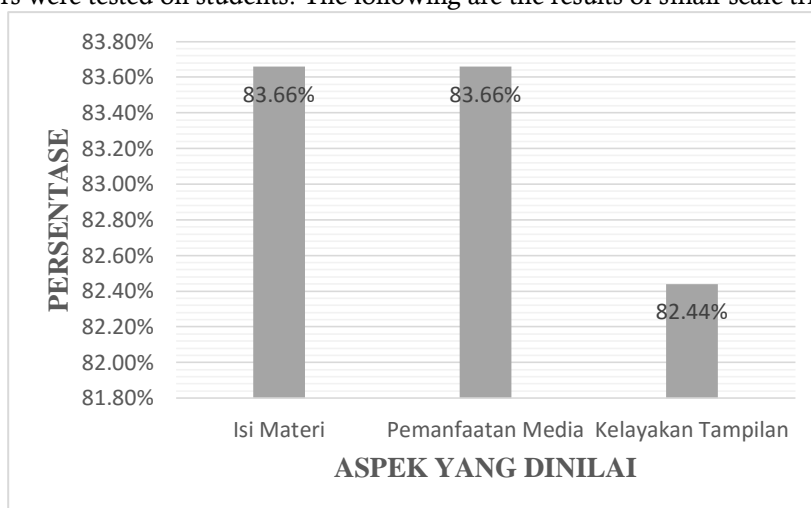

Figure 4. Small-Scale Trial Results

These results show the results of the percentage of small-scale trials on the aspect of the content of the material that is equal to 83.66% with a good predicate, in the aspect of media utilization it gets a percentage of 83.66% with a good predicate, in the aspect of display feasibility it gets a percentage of 82.44% with a good predicate. If the three aspects are calculated on average, it will produce 83.25% with a good predicate.

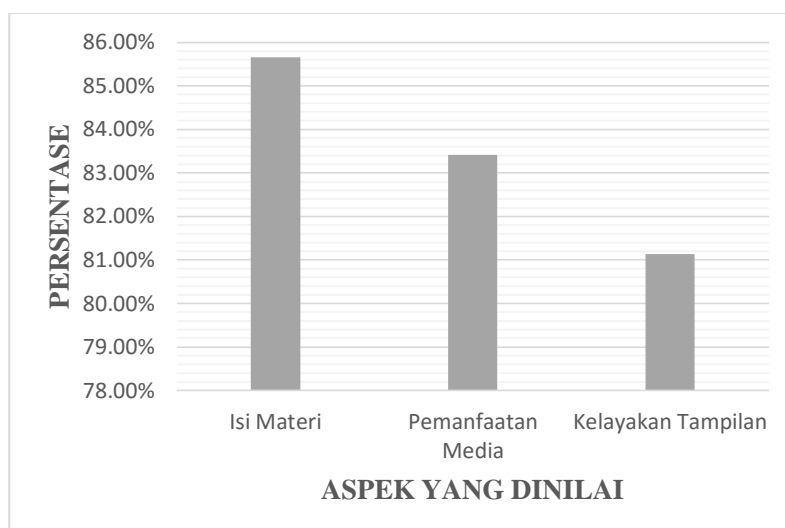The following are the results of large-scale trials:

Figure 5. Large-Scale Trial Results

These results show the percentage of large-scale trials on the aspect of the material content that is equal to 85.66% with a good predicate. In the aspect of media utilization, it gets a percentage of 83.41% with a good predicate. In the aspect of display feasibility, it gets a percentage of 81.14% with a good predicate. The following is a comparison of the percentages obtained through small-scale trials and large-scale trials:
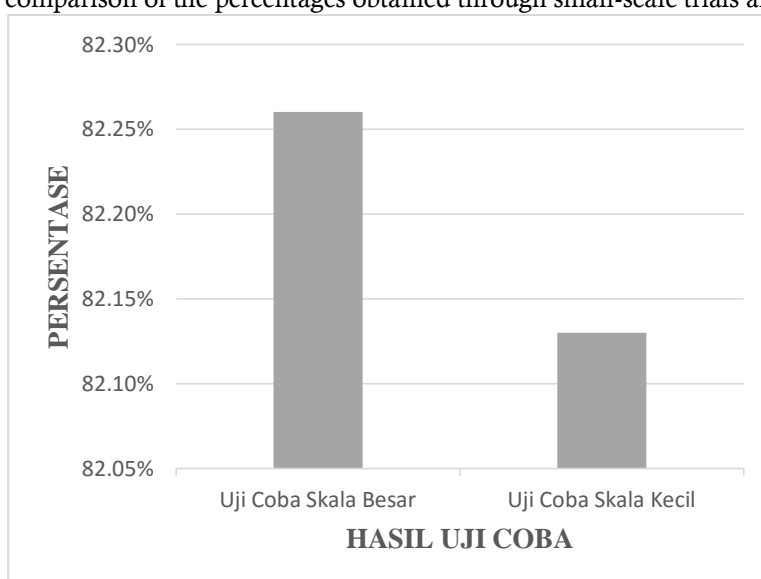

Figure 6. Comparison of Small-scale and Large-Scale Trial Results

The results of large-scale trials are 82.26%, and small-scale trials are 82.13%. When compared to the results obtained when conducting small-scale trials and large-scale trials, the percentage value increased by 0.13%.

Discussion

Based on the results of this study, it can be concluded several things regarding the development of learning media developed by researchers, namely: The final result of this development is an application which contains an e-book based on multiple representations with physics material for Class X SMA, where the e-book is equipped with competencies and indicators. Concept maps, learning materials are containing three chapters, sample questions, and practice questions. In addition, it is also equipped with pictures and videos related to the material discussed. The developed media has also passed the feasibility test stage by material experts and media experts. Assessment by material experts obtained a percentage of 92.66% in the excellent category. Assessment by media experts obtained a percentage of 76.06% in the excellent category. This proves that e-books are very well used as teaching materials. In terms of material aspects, they are very suitable for learning and aspects of media content that have met the standards. The findings

from (Filivani & Agung, 2021; Jariati & Yenti, 2020) also show that the material and media aspects strongly support the criteria requirements as standard limits used by students and teachers.

Based on the assessment of material and media experts, the media developed is feasible to use. In addition to being assessed by material experts and media experts, the media developed by researchers are also tested on students. Small-scale trials were conducted on 15 students. In a small-scale trial, it obtained a percentage score of 82.13% with a good predicate. Then a large-scale trial was also carried out with 60 students. The results of large-scale trials obtained a percentage of 82.26% with a good predicate. This means that the media developed by researchers can be said to be feasible to use. By the findings from (Nurilatifa & Wulandari, 2018; Sianturi et al., 2021), the material's content has met the appropriate criteria, and the display design is also very supportive of standard limits, so this media is expected to be able to support the learning process.

Comparative data on the results of the e-book media trial on students with small and large scales shows exciting results, where the large-scale trial scores above are from small-scale values. Thus this e-book media is perfect and able to meet the needs of the student learning process and very helpful for teachers in the teaching process. Findings were also made by (Nurlaela et al., 2021; Putri, 2021), where this comparison process will impact the readiness and needs of the learning process, and the final learning outcomes are getting better.

CONCLUSION

The e-book media significantly influences fluency and convenience and makes it easier for students to understand the material, and helps teachers in the learning process so that learning outcomes are expected to be better.

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