Development of Web-Based Physics E-Module Using Discovery-based Learning Model on Newton's Law Materials

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Abstract
The COVID-19 pandemic has led to online learning. The sudden learning process shift from offline to online causes new problems, including students’ difficulty in interacting during the learning process. The media used are usually only in the form of WhatsApp groups and emails which caused students to have difficulty understanding the lesson, limited learning resources and insufficient study time. One way to overcome this problem is to create a web-based physics e-module as an appropriate learning medium in this online learning period. The learning model used was discovery-based learning in order that students could find concepts independently. Therefore, this study aimed to develop a web-based e-module using a discovery-based learning model to increase student's interest and desire to learn. The development used in this research was 4-D (Define, Design, Develop, Disseminate). This research was carried out until the development stage. At the development stage, the e-module validation was carried out by 4 experts as validators. The validation results obtained were 87.8% with very valid criteria. Meanwhile, the practicality of this web-based physics e-module was carried out on students and physics teachers of class XI MIPA 1 SMA N 2 Padang Panjang with percentages of 89.6%, respectively, with very practical criteria. To sum up, this web-based physics e-module using a discovery learning model on Newton’s Law material was very valid and very practical to use.

INTRODUCTION
The COVID-19 pandemic is a health crisis first and foremost in the world. Many states decide to shut schools, colleges and universities (Purwanto et al., 2020). The COVID-19 pandemic has caused learning to be shifted from offline learning to online that requires students to learn through technology (mobile phones, laptops). This sudden change causes students to have difficulty interacting in the learning process. However, the rapid development of technology is very helpful in this online learning. Many online media can be used to guide students to study in a guided manner to improve student learning abilities. However, not all learning media are following the characteristics of students. Due to this condition, appropriate media are needed to help their previously abstract mindsets become concrete.

Internet network is needed in this online learning. Interaction between students and teachers can be done online using the internet. At first, the media used was only a WhatsApp group or email. Consequently, students had difficulty
in understanding lesson, limited learning resources, and insufficient study time. However, as time goes by, there are more and more media that can be used in online learning that can improve students' mindsets and make students and teachers technology literate.

Learning physics is not only learning that is required to master science in the form of facts, concepts, and various principles. Furthermore, physics is also a process in the form of investigations and also findings of science. Physics education should be able to provide a direct experience for students to carry out construction and be able to understand a concept being taught. Thus, students can improve their skills and can independently find a concept with meaning and also directly implicate it in the surrounding environment.

In learning physics, an approach that is appropriate to the characteristics of the material is needed according to the situation and students' abilities. According to the explanation of Permendikbud No. 24 of 2016, such need can be obtained by carrying out an indirect learning process (indirect teaching), such as setting examples, building habits, taking into account many things in each subject and the needs and situations of the students concerned. In the current condition, the media is anything that can be used as a form or a way to provide information from a source to a recipient to stimulate a mindset, awaken the enthusiasm of students in achieving the will to gain knowledge (Suryani et al., 2018). The use of appropriate learning media for the learning process can motivate students and assist students in mastering learning materials and concepts so that learning objectives can be achieved.

During the COVID-19 pandemic, teachers use the WhatsApp, Classroom, meeting, and zoom applications in the teaching and learning process where the teacher sends in the form of absences, teaching materials, practicing questions, and other assignments related to lessons. Learning resources are limited because books that students usually get from the library are difficult to obtain during online learning. The limited teaching materials make it difficult for students to master the learning materials, only expect what the teacher has given and access teaching materials from blogs/webs that have no source. This causes the learning objectives are not achieved maximally which has an impact on student learning outcomes.

Data obtained from SMAN 2 Padang Panjang on the scores of students' daily test results, especially on Newton's Law material, showed that the student's mastery level was still below 50%. The references used by students were also lacking because they could not use library as their learning sources during online learning. The teacher faced difficulty in filing all assignments and grades because the collection of assignments was not integrated into a media. One of the contributing factors was the low willingness of students to learn physics because the media used was still lacking and the online learning process carried out by the teacher was still limited to explanations via WhatsApp groups and occasionally using zoom meetings and classrooms, such as conventional learning in the form of lectures.

There are many researches conducted to make electronic module using web-media to attract student’s attention. One of them is the development of web-based learning media conducted by Divayana (Divayana et al., 2016), that showed that this media could train students' abilities and activities because they could study on their own at anytime and anywhere. Other study was Setyadi’s research that showed that students give a positive response to the development of web-based mathematics learning media (Setyadi & Qohar, 2017).

From the above problems and some researches, to overcome the use of media that has not been maximized, a web-based physics learning media design is needed. The supporting application used is an e-learning web that is following technological and scientific advances that are developing in this 21st-century era. The learning model used is problem-based learning as a way to improve students' thinking skills. This model is used because it makes students more focused on learning and understands and finds solutions to problems raised during learning more easily. This is the background of the research entitled "Development of Web-Based E-Modules Using Discovery-based Learning Models on Newton's Law Materials"
METHOD

Research and Development is applied as the method of this research. “Research & Development methods are research methods used to produce certain products and test the effectiveness of these products” (Sugiyono, 2018). Learning media of physics was developed in the form of e-module using web through systematic steps. Whether this e-module is suitable for use or not, a feasibility test was carried out in terms of material, media, and student interest in using this module.

The model used 4D model (define, design, develop, and disseminate) developed by Thiagarajan (Trianto, 2010). However, this research was only carried out until the definition stage, an analysis of the conditions of learning in schools was carried out to investigate problems and solutions that could be offered. The steps taken at this stage included an analysis of the availability of teaching materials in schools, supporting media provided by the school for the learning process, and the syllabus for physics subjects, especially physics material for even semesters.

The next stage was to design a web-based e-module using discovery-based learning model in Newton’s laws material. The steps taken at this stage were making an outline of the media program, making a flowchart, and compiling a story board design. Furthermore, the design objects are collected in the form of material text, questions and answers according to the e-module design, making animations and collecting backgrounds, images, sound effects, music, layouts and buttons. These objects are then processed in web and assembled with programming. The next step was finishing, namely reviewing and testing the program's readability. The last step of this stage was to create a product assessment questionnaire instrument.

The final stage of this 4D model was development stage. At this stage, there were two steps was done, namely the validation and practicality. At the validation step, the product and questionnaire responses of students were first vali which dated by 2 material experts, one media expert and one language expert. The validation results in the form of suggestions, comments, and input, were used to revise the developed product. In the practicality step, product trials were carried out in the classroom during the physics learning process. This stage was conducted to determine the practicality of the products that had been produced. After the trial was carried out in class, the questionnaires were distributed to the students to see the students' responses regarding the products that had been developed.

The data collected were not only qualitatively but also quantitatively. Qualitative data was in the form of which obtained through the process of developing learning media in the form of criticism and suggestions from the material, media, and language experts. Quantitative data, on the other hand were in the form of an assessment of learning media from material experts and media, and student responses to the products that had been developed.

RESULTS AND DISCUSSION

In the definition stage, interviews were conducted with students and teachers to find problems in the teaching and learning process in schools during courageous learning. Learning resources in the form of textbooks, which are usually available in schools, cannot be accessed by students because they are learning from home. Learning media when daring more often use WhatsApp groups and emails which have limitations in explaining physical concepts to students verbally and visually. The concept of independent learning that should be accepted by students cannot be carried out properly due to limited learning resources and lack of training obtained during learning. Although the teacher provides material in the form of lesson documents, it has not been able to arouse student interest in learning. Student activity can only be seen from the tasks given during learning. The results obtained from the tasks given to students are low because the learning process received is also limited. This is one of the reasons why the development of a web-based physics e-module using the discovery-based learning model needs to be done, especially learning materials about Newton's laws.

The second stage is product design which consists of several steps. The first is to identify the program. Program identification is done by
outlining the media program that contains subjects, classes, basic competencies, learning objectives, and the media used. Second, the creation of a flow chart that contains the program from start to exit. The design of this e-module starts with logging in first. Then the homepage and the contents of the module are displayed, such as materials, animations/videos, evaluations, and others shown in the image. The third step is to create a storyboard which is a description of the flow chart. The storyboard starts with a login screen that contains the user name and password fields that must be filled in by students and teachers to access the web. Then a homepage will appear showing all the features in the e-module. “Student list” contains the name and date of registration of the student. This menu only appears on teacher accounts. “List of materials” contains core materials, core competencies, basic competencies, and concept maps. The "animation/Video" menu displays videos or simulations related to the material. "Evaluation" contains evaluation questions. The "evaluation" display on the teacher's account has an additional menu where the teacher can add evaluation questions. "Question and Answer" serves as a communication space for the students and the teacher. The "absent" menu is where students fill out the attendance list. The appearance on the teacher's account is slightly different where the display of student names will appear so that teachers can check student attendance. Instructions for using the e-module are displayed in the “Tutorials” menu. Reference sources used in making e-modules can be seen in the "bibliography/sources" menu. Finally, the "about developer" menu contains information about the e-module developer. The fourth step is to collect materials with an analysis of technical specifications related to the supporting applications used and analysis of program work to find out how to operate the program. The final step in the design stage is finishing, which is to package the completed program in the form of an application link that can be accessed by teachers and students. The final result (Suryani et al., 2018) can be seen in Figure 1.

Figure 1. Display of Web-Based Physics E-Module: (a) login display (b) menu display (c) material display (d) Animation/video display
At the development stage, product validation and practicality tests were carried out. In the validation stage, the e-module that had been developed was validated by 4 experts. The aspects assessed were the content, format, language, and design of the module. From the four validated aspects, an average of 87.8% was obtained. This means that this module was considered valid to use. The results can be seen in Table 1.

The next stage is the practical stage. This e-module was designed not only for students to use but also for teachers. Therefore, at this stage, a practical test of teachers and students was carried out. The aspects assessed were instructions, content, and ease of use. The average student considers that this e-module was very valid with a percentage of 90.8%. From the teacher's point of view, the instructions and content aspects were considered very practical with a large percentage of 80%, while in terms of ease of use, the teacher considers this e-module was practical. Overall, this e-module is considered very practical to use with a percentage of 89.6%. (See Table 2).

**CONCLUSION**

In this research, the Web-Based Physics e-Module Using Discovery-Based Learning Model on Newton's Law Materials has been successfully developed. Validation of this module is included in the very valid category with a percentage of 88.6%. The practicality test showed results of 89.6%. It means, the e-module that has been developed are very practical. Thus, this module can be categorized as very valid and very practical to use.

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