Website of Physics Instructional (WoPI): Learning Physics from Home During COVID-19

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Abstract. In recent years, the education system, especially in Indonesia, has begun to adapt to distance learning. Technology in the field of education has emerged. Therefore, this research has the aim of producing an E-module based on a STEM with website-assisted in learning Physics on rotational dynamics. This research was conducted by applying the research method of FODEM (Formative Development Method) and was limited to the development phase. The results of this study are E-module learning media assisted by a website that can be used through various electronic devices, with learning material based on the STEM (science, technology, engineering, and mathematics) approach that can help students understand physics subjects in rotational dynamics. Further research is needed regarding the validation of this STEM-based E-modules assisted with website.

1. Introduction
Technology continues to develop and progress quite rapidly, then accurate information becomes very important for everyday life. Technological advances are able to change the norms that already exist in society. The field of education itself can be assessed as a form of development of information technology as a medium of information during the teaching and learning process [1]. Information technology is used by humans to help humans solve existing problems. Then, when the world was hit by a disaster that caused learning not to be done directly, then education was carried out remotely with the help of the internet. Technology successfully solves problems regarding learning that should not be done directly, but there are other problems that need to be considered, there are three classifications of problems that are obtained when conducting distance learning, namely; The teaching and learning activities carried out still need development, the use of appropriate technology, and in the personal or residential environment [2].

Physics is the science that underlies the natural sciences obtained from the results of experiments and theory development [3]. Physics subjects become a problem for students. Most students have problems with physics. In addition, teaching materials in physics subjects are also less developed [4]. A study was...
conducted related to understanding the material in physics subjects, then it was found that as many as 56.45% of students stated that the rotational dynamic material was the least easy material to understand. While the percentage of understanding of other materials is 1.61% for elasticity, 6.45% for static fluid, 9.68% for dynamic fluid, 6.45% for temperature and heat, and 19.35% for gas kinetic theory [5]. Then another research was conducted on the students' ability to understand the topic of rotational dynamics to 29 high school students. To measure students' understanding ability with the pretest device, it was found that one question did not answer correctly, and three other questions students answered incorrectly (<30% answered correctly) of the 9 questions given. This is because many students still have difficulty in understanding the basic concepts of rotational dynamics [6].

The thing that causes rotational dynamic material is difficult to understand because the material is presented pragmatically. Teaching materials are only composed of definitions, display formulas, and practice questions. The concept of the material being studied is only on the surface. Then students also find it difficult to solve various problems related to rotational dynamic material [7]. To be able to solve problems related to appropriate learning media, one of them is E-module with the help of a website. This website-based E-Module is very well used as a learning medium [8].

Problems related to learning activities and understanding of learning can be overcome with a STEM learning approach (Science, Technology, Engineering, and Mathematics). STEM is a learning approach that is popular at the world level, this approach is said to be effective in the application of learning in integrative thematic because it integrates four areas of knowledge: science, technology, mathematics and engineering [9]. A study related to the application of the STEM approach to vocational students for small group trials obtained a score of 79.7%, and trials in large groups obtained an average score of 68%, so it can be said to be effective and valid [10].

Referring to the explanation above, it is necessary to develop learning media in the form of an E-module based on a website-assisted STEM approach to learning physics on rotational dynamic material and it is hoped that this media can have a positive impact on students and can help students understand the learning material. Therefore, the author plans to develop a website-assisted STEM-based E-module for learning physics on rotational dynamic material. The e-module is intended for students who are in the upper secondary education level. In addition, this E-module will be used as a choice of learning media that can be applied in the learning process by teachers.

2. Method

This research was conducted by applying the FODEM (Formative Development Method) research method. FODEM is a product design approach that aims to support the design and development of various kinds of technological innovations in education, such as learning tools and online learning programs. This method has three important components, namely Need Analysis (NA), Implementation (I), and Formative Evaluation (FE) [11]. The number of threads of research can be more than one and the thread of research can be carried out in parallel or can go hand in hand without waiting for another thread to finish first in carrying out the development. In simple terms the flow of FODEM as shown below [12].

![Figure 1. Simple flow of Formative Development Method (FODEM).](image)

From this simple flow, it is applied to the research stage by limiting research only to the development stage. The research steps to be carried out are depicted in the following figure.
3. Result

The e-module resulting from this development is named WoPI (Website of Physics Instructional). This e-module discusses Rotational Dynamics material by integrating the fields of STEM (science, technology, engineering, and mathematics) to make these teaching materials more up-to-date and this teaching material prepares students in the future by practicing critical and creative thinking skills, systematically and logically. So that they are able to meet 21st century human resource standards and are able to face increasingly complex global challenges [13]. The form of this E-module is a website, so that it can be accessed from all devices, both mobile phones, laptops, and even smart televisions can access it.

Figure 2. Website Assisted STEM-Based E-module development research flow

Figure 3. Login page view
Before learning, students are required to login using an account that has been registered first. This account registration function is useful for storing student learning progress and other profiles.

Figure 4. Home page view

After logging in with an account that has been registered, students will go to the start page, where on this page a student account is presented, then displays student learning progress on the material that was last worked on, and displays a list of materials that can be studied.

Figure 5. Material information page view

After students select the material to be studied, students will enter a page that displays information on the material such as learning objectives, basic learning competencies and also a list of activities to be followed in carrying out learning.
In the list of activities on the information page, when the activity is opened, other activities will appear. There are activities that are green and gray. The green color on the activity indicates that the activity has been studied, while the gray color indicates that the activity has not been studied and cannot be opened, this system is made so that students learn the material in sequence without missing a single learning activity.

Because the learning materials are made based on the STEM approach, the material presented integrates four fields of science which include natural sciences, technology, mathematics, and engineering. The following is how the material presented is applied based on the STEM approach:

**Table 1. Student learning activities on rotational dynamics**

| Aspect       | Activity                                                                 |
|--------------|---------------------------------------------------------------------------|
| **Science**  | - Students are given the questions related to opening doors                |
|              | - After that, the material is presented to verify the students' answers whether they are in accordance with the existing theory. |
| **Technology** | - Connecting materials with technology that applies the concept of torque, one of the door closer technologies, a tool that functions to close the door automatically. |
| **Mathematics** | - Students are given practice questions by applying the mathematical formulas contained in the concept of torque. |
| **Engineering** | - Students are asked to make a simple project assignment from the door closer using the principle of |
Aspect | Activity
--- | ---
- | In working on project assignments, students are asked to start from planning, designing the tool to be made, until the tool is finished.

**Self-balance motorcycle**

**Science**
- Students are asked how a motor can balance itself
- After that, the moment of inertia and angular momentum were presented to verify the student's answer whether it was in accordance with the existing theory

**Technology**
- Connecting materials with gyroscope technology, which is the main factor in making the motor self-balanced

**Mathematics**
- Students are given practice questions by applying the mathematical formulas contained in the concepts of moment of inertia and angular momentum.

**Engineering**
- Students are asked to make a simple gyroscope with a cassette that can be found at home
- In working on project assignments, students are asked to start from planning, designing the tool to be made, until the tool is finished.

**Cycling**

**Science**
- Students are asked how the kinetic energy is experienced by a moving bicycle
- After that, the kinetic energy material on the rolling object is presented to verify the student's answer whether it is in accordance with the existing theory

**Technology**
- Connecting materials with existing technology on a modern bicycle to improve performance

**Mathematics**
- Students are given practice questions by applying the mathematical formulas contained in the concepts of moment of inertia and angular momentum.

**Engineering**
- Students are asked to design a bicycle design by considering the kinetic energy of the bicycle

4. **Conclusion**

The website-assisted STEM-based E-module learning media for physics learning on rotational dynamic material was developed using the FODEM (Formative Development Method) research method. This e-module is presented in the form of a website so that it can be accessed from all devices, whether mobile phones, laptops, even smart televisions can access it. This e-module is designed and structured based on the STEM approach, so that the material presented integrates science, technology, engineering, and mathematics. This research still requires further research related to the validation of STEM-based E-modules assisted by websites until finally the media is suitable for use by teachers in the learning process.

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