Development of Electronic Physics Learning Module With Phet (Physical Education and Technology) Simulation on Elasticity and Hooke Law in Class Xi Senior High School

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Abstract. One way to use technology in learning is by using Simulation Physics Education and Technology (PhET). This article describes the results of the development of an electronic module for learning physics about elasticity and Hooke's law in class XI SMA. This research method is Research and Development with ADDIE model. The steps in this development are making needs assessments, analyzing materials, designing electronic modules, developing assessment tools, realizing electronic module designs, product validation by experts, testing electronic modules by teachers and students and performing evaluations. Based on the needs analysis conducted in class XI MIPA SMAN 107 Jakarta on 58 students, the results were obtained: 98.23% of students have difficulty understanding the physics material during PJJ, 94.83% of students are interested in the use of electronic modules as a companion for self-study at home and 87.72% of the students chose a module with instructions for independent practicum. The electronic module supported by that simulation is an alternative teaching material that can be used by students for self-study and can be used to conduct virtual experiments. The results of this research have been validated by physicists, learning experts and media experts.

1. Introduction
Physics is a science that studies nature and natural phenomena or natural phenomena and all the interactions in it that can be observed by humans. Learning physics can benefit from experimentation to help students understand physics lessons. The problem that students often face when learning physics is the difficulty of understanding the material [1]. This can happen because teachers only teach abstract physics through classroom learning and not all of them are equipped with lab experiments. Experiments in labs often face obstacles, including concepts that are difficult to observe through experiments, are dangerous to perform through experiments, incomplete tools, and others [2]. In addition, the fact that Covid-19 has disrupted all segments of human life on earth, without exception of education. The impact of this pandemic is that all students have to undertake the online learning process or popularly referred to as a Distance Learning (PJJ). The impact of this pandemic is that all students have to undertake the online learning process or popularly referred to as a Distance Learning (PJJ) [3]. Therefore, we need teaching materials that are practical, interesting and interactive and can be used by students to study independently at home, and can replace the role of conducting experiments in school labs. An alternative is through the use of other teaching materials, such as using technology-based teaching materials that are not limited by place and time. Based on these problems, this research will develop an electronic module, supported by PhET (Physical Education and Technology) simulation on Elasticity and Hooke's Law. Get interactive simulation is an example of multimedia applications in the education world that
are expected to support students' understanding of physics concepts assessed through comprehension tests. Therefore, this research focuses on developing an electronic module, supported by that simulation on Elasticity and Hooke's Law, as an independent learning material to help increase students' understanding.

2. Method
The method that is used in this research is the research and development method to ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model.

![Addie Model Flow](image)

**Figure 1. Addie Model Flow**

2.1. Analysis
At this step, questionnaires are distributed to students to identify learning objectives, determine appropriate media, approaches, and materials for students, and find out what processes and facilities are available in learning. Based on the needs analysis, 94.83% of students are interested in using electronic modules as a medium for self-study at home and 87.72% of students choose modules that contain steps for using physical materials simulation with PhET. In addition, it was found that students had difficulty understanding the material because there were no experiments in the laboratory in distance learning.

2.2. Design
The goal in this step is to design an electronic module. At this step, the researcher collects information about the product to be developed. In addition, at this step, the researcher makes a research schedule flow to make the development of electronic modules on time according to the schedule and planned research activities.

2.3. Development
At this step, the realization of the development of an electronic module, supported by that simulation on Elasticity and Hooke's Law. On the first page of the module there is a cover, then the next sheet contains core competencies, basic competencies, concept maps, introduction to the material, material, sample questions, practice questions, steps in conducting experiments with PhET, a summary of the material, formative tests and answers on formative tests.

2.4. Implementation
In the implementation phase, validation tests were carried out by material experts, media experts, and learning experts. This validation test is intended to analyze the feasibility of the electronic module developed as a form of teaching materials/materials for students. In this case, the validation test by the expert was carried out through the distribution of questionnaires using a Likert scale. Improvements will be made based on the input given to the validation process by experts. After that, the product readability test was carried out by high school physics teachers and high school students in class XI.

2.5. Evaluation
At this step, an evaluation of the electronic module that has been tested on teachers and students is carried out. Are there still deficiencies in the developed electronic module. If there are still shortcomings, it is necessary to carry out an evaluation step to perfect the developed electronic module, namely the evaluation of unmet needs in the develop electronic module.
3. Result and Discussion
The result of this research and development is an electronic module for physics learning supported by simulation on the elasticity and material of Hooke's law for class XI SMA as a learning medium that can facilitate students in independent learning that can be accessed anywhere, anytime. These are the components of the developed electronic module:

| Early Section       | Contents Section          | Final Section                |
|---------------------|---------------------------|------------------------------|
| Cover               | Material introduction     | Evaluation                   |
| Foreword            | Learning material         | Bibliography                 |
| Table of contents   | Problem’s example         | Lesson plan                  |
| Basic competencies  | Exercises                 | Author’s identity            |
|                     | Instruction for use that  |                              |
|                     | Summary                   |                              |

Below is the initial design of the Phet simulation-assisted physics learning electronic module on elasticity and Hooke's law material for class XI developed:
The Phet Simulation Assisted Electronic Module is a digital module systematically arranged to cover all components of a module and equipped with a Phet simulation so that it can be used as independent teaching material to help students understand the topic of Elasticity and Hooke's law. The electronic module supported by that simulation is an alternative teaching material that can be used by students for self-study and can be used to conduct virtual experiments. Phet simulation makes students more active and effective as a teaching material [4]. Moreover, through the use of Phet teaching materials, students better understand the concept as they are directly involved in conducting experiments [5].

Research by Siti Nur Khalifah [6] concluded that Phet simulation of distance learning physics has a positive effect on increasing the concept mastery ability of high school students. The electronic module was chosen because it is flexible, accessible from anywhere and only requires supporting electronic devices. The Phet Simulation Assisted Physics Module is also a teaching material that can increase students’ enthusiasm for independent learning, as the Phet Simulation Assisted Physics Electronic Module contains materials, sample questions, practice questions, and formative tests and answers so that students can ask and practice. Independent [7]. In addition, the PhET Simulation-Assisted Physics module is equipped with guidelines and experimental steps for accessing and using PhET simulations, allowing students unfamiliar with that simulations to experiment. Based on research conducted by Adams, et. Al. [8] Showed that the Phet media can visualize the concept of the material well. Phet simulation experiments are easily accessible to students as they can be accessed on their own electronic devices. That simulation can be done repeatedly so that it helps the students to understand the learned physics concepts. Research by C E Rustana et al [9]. Showed that students who taught using interactive PhET simulations had better learning outcomes than those taught using the experimental method using laboratory kits, especially for the kinetic theory of gases.

Based on the formulation and research objectives, and various related theoretical studies, by with the ADDIE research and development model, this Phet simulation-assisted electronic module was created. Starting with creating a needs analysis completed by students to use as initial data, then continuing with a literature search related to electronic modules and PhET simulations. Then create product designs, develop products, validate with materials experts, learning experts, and media experts, after which it continues to review the validated products. After the product has been declared valid, field trials are carried out. If the results of the student product trial are successful, they can be used without reviewing the product. But if it fails, the product must be repaired and revalidated from a material perspective, then tested to show the desired results. Finally, the results of the research in the form of a Phet-supported electronic module on elasticity and Hooke's law are expected to be useful and become one of the alternative teaching materials for students to use when conducting virtual experiments.

4. Conclusion
In this research, a product is an electronic module for learning physics with the aid of Phet simulation of elasticity and Hooke's law material for class XI SMA, which was used as an independent learning teaching material to help increase students' understanding. This study uses research and development
methods using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Researchers hope that the developed electronic module can be used as an alternative for independent teaching materials for students and can help in the learning process.

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