The Development of Virtual Laboratory Assisted by Flash and PhET to Support Distance Learning

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Abstract. This research aims to develop and produce a virtual laboratory, assisted by Adobe Flash and PhET simulation that is suitable for use as a learning resource and can help support physics practicum during the distance learning process on the fluid material for students of class XI in high school. The research method used is research and development method to ADDIE model (Analysis, Design, Development, Implementation, Evaluation). This virtual laboratory is made with the help of Adobe Flash applications and PhET simulations. Based on the results of needs analysis in several high schools in Jakarta and Bogor with total of 135 respondents, 69.6% of respondents stated that they did not do physics practicum during distance learning, 71.1% of respondents said they could better understand physics with virtual laboratory, 68.1% of respondents said they needed a virtual laboratory for fluid material, and 88.1% stated that virtual laboratory on fluid material practicum helped understand the material during distance learning. A feasibility test of virtual laboratory on fluid material practicum assisted by Adobe Flash and PhET simulation was validated by material and media experts using a validation test questionnaire. Then, trials were carried out by students and teachers of class XI in high school.

1. Introduction
At the end of 2019, coronavirus disease 2019 or COVID-19 appeared in Wuhan, China [1]. The emergence of COVID-19 has a major impact on human activities in all fields of life, including education. The change from face-to-face learning to distance learning is one of the impacts. In education, the Indonesian government issues a policy to limit the spread of COVID-19 by changing the teaching and learning process where is usually done face-to-face into distance learning [2].

Distance learning is learning in which teacher and student are separate and the learning uses various learning resources through the application of the principles of educational technology [3]. The absence of direct interaction and the difference in location between teacher and student are characteristics of distance learning [4]. However, during this distance learning, many schools are unable to do practicum on physics learning. Based on the results of a needs analysis survey that was carried out. 69.6% of 135 respondents stated that they did not do practicum on physics learning during the distance learning process. From Serevina and Khaerunisa’s research, the need for distance learning devices with Newton's Law material on the analysis of student needs at 89.2% [13], but in this research students need for distance learning devices with fluid material at 71.1%. Learning devices are needed to help students learning physics in distance learning. Therefore, virtual practicum using a virtual laboratory can be a solution for practicum during the distance learning process.
A virtual laboratory (virtual lab) is one of the ICT-based learning processes that can be used as an alternative solution for learning with practical methods [5]. A virtual laboratory contains a simulation program for activities carried out in a computer-assisted laboratory [6]. A virtual laboratory can simulate practical activities in a laboratory-like being in a real laboratory. The existence of a virtual laboratory also makes it easier for schools that do not have a laboratory. Based on the results of the needs analysis survey that has been carried out, 71.1% of 135 respondents felt they can better understand physics learning with the virtual laboratory. The materials that are used to develop the virtual laboratory are static fluid and dynamic fluid. Fluids materials are closely related to everyday life and there are rarely practical tools for fluid materials available [7]. Based on the results of the needs analysis survey, 68.1% of 135 respondents felt they needed a virtual laboratory for fluid practicum. Then, 88.1% of 135 respondents felt that the existence of a virtual laboratory for practicum helped to understand fluid learning materials.

The applications used to help develop the virtual laboratory in this research are Adobe Flash and PhET Simulation. One of advantages of Adobe Flash CS Professional is that it is the most flexible program in creating animations, such as interactive game animations, company profiles, presentations, movies, e-cards, and animations used in websites [8]. Peat contains abstract physics animations or cannot be seen by an open eye [9]. From the analysis survey, 25.6% of 135 respondents felt that having a virtual laboratory for practicum made it easier to understand learning materials during the distance learning process, and 73.3% felt that having a virtual laboratory for practicum was able to make learning fun during the distance learning process, and 65.9% felt that having a virtual laboratory for practicum made them more interested in learning during this distance learning process. Based on that reason, this research was carried out with the title “Development of a Virtual Laboratory in Adobe Flash-Assisted Fluid Material Practicum and PhET Simulation to Support Distance Learning”.

2. Research Method

The research method used in this research is research and development methods with the ADDIE model. ADDIE is an acronym for Analyze, Design, Develop, Implement, and Evaluate.

![ADDIE concept](image)

In the ADDIE model, there are five stages which include analyzing, design, develop, implement and evaluate (Figure 1) [10]. At the analyze stage, a needs analysis will be carried to identify the problems and needs of students. At the design stage, a design for the product will be made and created. Then at the development stage, the product will be developed and will be validated by material and media experts. At the implementation stage, the product will be tested on student and teacher in high school. After the product has been tested, student and teacher will be given a questionnaire regarding responses, criticisms, and suggestions related to the product that has been tested. At the evaluation stage, a formative evaluation will be carried out to determine the advantages and disadvantages of the product. The results of this evaluation determine whether the product has revisions or not.
3. Results and Discussion

Based on the steps of the ADDIE model, the results of the following research procedures are as follows:

3.1 Analyze

A needs analysis to identify the problems of students in learning physics during distance learning has been carried out. Based on the results of needs analysis in several high schools in Jakarta and Bogor with a total of 135 respondents, 69.6% stated that they did not do physics practicum during distance learning, 71.1% of respondents said they could better understand physics with virtual laboratory, 68.1% of respondents said they needed a virtual laboratory for fluid material, and 88.1% stated that virtual laboratory on fluid material practicum helped understand the material during distance learning.

3.2 Design

At this stage, the design of the virtual laboratory was carried out by determining the subject matter, designing the storyboard for the virtual laboratory to be developed. In this research, the subject matter that will be used fluids material.

3.3 Develop

At this stage, after the virtual laboratory was designed. Then, the virtual laboratory developed using Adobe Flash CS6 and PhET simulation. After the virtual laboratory was done. The virtual laboratory validated by material and media experts. If the virtual laboratory has flaws after being validated. Then, it will be revised. If the virtual laboratory is valid then is ready to be tested at the next stage. The following is the virtual laboratory that has been developed:

![Virtual Laboratory Introduction and Main Menu](image1)

**Figure 2.** Introduction of virtual laboratory and the main menu

In the top left corner of the main menu, there is a tab menu. In the top right corner of the main menu, there is the exit.

![Tab Menu](image2)

**Figure 3.** The tab menu
The tab menu consists of home, core competencies and basic competencies (KI and KD), fluids practicum list, and profile. The following is part of the list of practicums:

**Figure 4.** Fluids practicum list

The fluids practicum list consists of five practicum. One of them comes from pet simulation, shown in Figure 5. For pascal’s law, water discharge, Bernoulli’s law and viscosity made using Adobe Flash CS6. The animation shown is a complex animation in which the object, background and movement of the display from adobe flash can be created by the user [12]

**Figure 5.** PhET simulation

**Figure 6.** Pascal’s Law simulation

In figure 6 is a simulation of Pascal's law on a hydraulic lift in a virtual laboratory made using Adobe Flash CS6. A virtual laboratory is a laboratory used by students in conducting experiments without the need
for real laboratory equipment [11]. In this pandemic situation, students can do a practicum using virtual laboratory.

3.4 Implementation
At this stage, the virtual laboratory validated by material and media experts using a validation test questionnaire. Then, trials were carried out by students and teachers of class XI in high school tested in Jakarta.

3.5 Evaluation
At this stage, determine whether the product is suitable for fluids practicum learning media or not.

4. Conclusion
This research produced a virtual laboratory in fluid practicum assisted by adobe flash and PhET simulation to help support distance learning of class XI in high school. A virtual laboratory helps students to understand physics and do physics practicum during distance learning. This research is still in the development stage. Hope researchers can develop more perfect virtual laboratories for various other physical materials.

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