The development of virtual laboratory on fluid materials

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Abstract. This study aims to study the development of laboratory learning media on the concept of fluids. The method used in this study is the research and development (R & D) method of implementation up to step 7, namely: (1) literature study, (2) needs analysis, (3) design of virtual lab learning media, (4) development of lab learning media virtual, (5) validation, (6) product testing, (7) product revision. Virtual laboratory learning media, have gone through a phase validation test by two material experts and one media expert who showed that laboratory learning media on fluid materials are feasible to be applied in learning. the results of sponsored pretest and posttest for students showed a significant increase. Recommended to be applied in a virtual learning laboratory is suitable to be applied in the Faculty of Engineering, Majalengka University.

1. Introduction

Practicum is very important activity in science study, especially in the field of Physics studies. Physics material in addition to being delivered in the form of theory also must be supported by practicum activities so that the subject matter is delivered more easily understood and more real for abstract things [1]. In this case the existence of a laboratory in science learning has an important role, but laboratories are often not used because of the limitations of tools and materials.

Like the state of the Basic Physics laboratory at the Faculty of Engineering, Majalengka University, the practicum equipment was partially damaged and unfit for use, so some physical materials cannot be practiced easily using measurement and fluid practices. This has an impact on student learning outcomes in low physics courses. To deal with these problems, previous researchers have conducted research, namely with the research title 'Virtual laboratory learning media development to improve the science of literacy skills of mechanical engineering students on basic physics concept of material measurement' [2], in this study using a macromedia flash program so that there are some disadvantages, including: (1) limitations in practicum, students are not free in lab-vir because the results and movements have been determined; (2) separate student worksheets with the program, this makes it more simple; and (3) students are still confused in operating it so that it takes a long time in learning.
To overcome these problems, researchers redeveloped virtual laboratories by uniting several programs in a virtual laboratory, so students are expected to be easier to use lab-vir, thus students’ understanding of the concept of physics can increase. The program includes Adobe CS6, Adobe Photoshop for image editing, Adobe Illustrator for editing vector, PhET, Java and Adobe text editor for student worksheets. Student interest during learning with the PhET media-assisted media approach and Student Worksheets, has increased in each cycle [3].

In this virtual laboratory that is developed, namely in fluid material, because fluid material is closely related in everyday life. While at the research location there is no fluid practicum tool available. Therefore, it is very appropriate to develop virtual laboratory media in fluid concepts.

This research is also on the basis of the successes of previous researchers who have used virtual laboratories. Virtual lab learning methods can be used as an alternative in the limitations of practicum equipment [4]. In the teaching and learning process students look more active in terms of asking questions about the material being taught, this shows students are interested in using virtual laboratories [5]. The results of the study found that students who used a high-thinking virtual laboratory (HOTVL) in laboratory activities had higher scientific communication skills than students who used virtual laboratory verification [6].

It can be concluded that virtual laboratories can be used as alternatives in the limitations of practicum tools, students are more active in asking questions, so that scientific communication skills can be improved. So that it becomes the basis for researchers to develop virtual laboratories, the problem in this research is "How is the development of virtual laboratories in fluid material?"

2. Methods
The suitable method in this study is the Research and Development (R&D) method, which is to perfect the existing product.

Virtual laboratory learning media on fluid mechanics materials. The steps in virtual laboratory learning media and this development have adopted the steps of Borg and Gall's [7]. the steps are as follows: 1) Potential and Problems, 2) Data Collection, 3) Product Design, 4) Validation Design, 5) Revision Design, 6) Product testing, 7) Product Revision, 8) Trial of Use, and 9) Mass Production. This research is limited to the steps of media development to point 7.

The population in this research were all Engineering students in the first semester at one of the university in Majalengka in the academic year 2017-2018. While the sample in this research was taken one experimental class, namely the IA semester mechanical engineering class with the number of students 13.

In the use trial, students were given a pre-test before being given treatment in learning using a virtual laboratory that had been developed, after that it is given a post-test. To find out the increase, it is calculated by the N-Gain formula [8]. The formula is as follows:

\[ N - Gain = \frac{Spost - Spre}{Smaks - Spre} \]  \hspace{1cm} (1)

Where Spost - Score of post-test, Spre - Score of pre-test, Smaks - Ideal maximum score.

3. Result and Discussions
The design of developing virtual laboratory learning media in fluid mechanics material contains the concept of static fluid and dynamic fluid. In addition to presenting a brief explanation of these concepts, in the development of virtual laboratory learning media practicum is presented using virtual laboratories with phET simulations and equipped with student worksheets in the form of PDF applications. The development of this virtual lab. learning media uses applications: Adobe CS6, adobe photoshop for image editing, adobe illustrator for editing vector, PhET, java and adobe text editor for student worksheet.

Learning media before being widely used must be evaluated in advance, both in terms of material, educational aspects and in terms of software engineering, so that the learning media meets the requirements for use in the learning process [8]. Evaluation is intended to find out whether the media developed can achieve the stated goals. This is very important because many people think that once making media is certainly good. The initial testing process was carried out by consulting media
experts and fluid mechanics material experts through the design validation process. Then the design revision is processed until it is declared feasible by experts, then the next step is to do a limited test. The results of the validation of virtual laboratory learning media by 2 content experts and 1 media expert, stated that the learning media of virtual learning are feasible to be used in learning. Limited test results obtained from the results of the pre-test and post-test that were tested on students, as in the following figure 1:

![Figure 1. Limited test results data](image)

From the figure 1 above obtained an average pre-test score of 5.69 to 15.23 in the post-test. So, the N-Gain value is 0.72, the number is in the high category. Thus, the media develops virtual laboratories on materials suitable for use in learning. Learning based on Lab-Vir media provides opportunities for students to explore, It is possible for them to always be active, not just listen and copy [9]. Lab-Vir with the right learning tools can be very active in learning [10].

This picture is a display of virtual laboratory learning media on fluid concepts.
4. Conclusion
Virtual laboratory learning media developed on Fluid Mechanics material have fulfilled the requirements suitable for use in learning.

5. References
[1] Henlenti, Syamsurizal, Asyhar R 2014 Development of the Virtual Lab for Learning and Teaching of Optics for Students of the 8th grade of State Junior High School I Tungkal Ulu J. Edu-Sains 3 2
[2] Jannati ED, Setiawan A, Siahaan P, Rochman C 2018 Virtual Laboratory Learning Media Development to Improve Science Literacy Skills of Mechanical Engineering Students on
Basic Physics Concept of Material Measurement Journal of Physics: Conference Series 1013 (1), 012061

[3] Siregar A 2016 Introductory Learning of Quantum Physics With Take Advantage of The Media PhET Simulation and Student Worksheet Through Scientific Approach: Impact on Interest and Mastery of Student Concepts Jurnal Ilmiah Pendidikan Fisika Al-BiRuNi 05 (1) (2016) 53-60

[4] Salam H, Setiawan A, Hamidah I 2010 Virtual Laboratory-Based Learning to Improve the Concept of Concept in Dynamic Electrical Materials Proceedings of The 4th International Conference on Teacher Education; Join Conference UPI & UPSI Bandung, Indonesia, 8-10 November 2010

[5] Hermansyah, Gunawan, Herayanti L 2015 The Effect of Use of The Virtual Laboratory on Concept of Creative Thinking Concepts and Abilities on Vibration and Wave Materials Jurnal Pendidikan Fisika dan Teknologi 1 (2)

[6] Sapriadil S, Setiawan A, Suhandi A, Malik A, Safitri D, Lisdiani SAS, Hermita N 2018 Optimizing Students’ Scientific Communication Skills Through Higher Order Thinking Virtual Laboratory (Hotvl) Journal of Physics: Conference Series, 1013(1)

[7] Sugiyono 2013 Research Methods (discussing Quantitative, Qualitative, and R & D) (Indonesia: Alfabeta)

[8] Meltzer D E 2002 The Relationship Between Mathematics Preparation and Conceptual Learning Gain in Physics: A Possible “Hidden Variabel” in Diagnostics Pretest Scores American Journal of Physics 70 12 1259-1268.

[9] Syahdiani, Kardi S, Sanjaya I G M 2015 Development of Inquiry-Based Interactive Multimedia in the Material of Human Reproductive Systems to Improve Learning Outcomes And Practice students' critical thinking skills J. Pend. Sains Pascasarjana UNS. 5 1

[10] Tuysuz C 2010 The Effect of the Virtual Laboratory on Student’s Achievement and Attitude in Chemistry International Online J. of Edu. Sciences 2 1 37-53

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