

The Development of a Virtual Laboratory as a Virus Learning Media to Improve Student Learning Outcomes in Biology Subjects



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ABSTRACT: One of the materials in biology is about viruses, which are known as "abstracts" because students cannot observe them easily. As a result, it is difficult for students to comprehend. When students were conducting practicums in the laboratory, the researcher also found that the results of the test were much lower than the minimum standard score of 75/100. Therefore, the purpose of this development research is to develop a virtual media laboratory for viral material as a learning medium that facilitates teachers and students in the learning process, which is expected to improve student learning outcomes. This research uses an R & D approach with 4D models. It consists of defining, designing, developing, and disseminating procedures. This study was done at SMA Singapore National Academy Sidoarjo with grade 10 students.

The Virtual Laboratory consists of the design of learning media that will be developed in the form of story boards on viral materials developed with Adobe Flash CS6 software. According to material, design, and media experts' assessments, the media got a score of 100%, 84.28%, and 87.1%. It means that this virtual laboratory innovation can be excellent for use in a real-life learning activity. It means that this virtual laboratory innovation can be excellent for use in a real-life learning activity. The results of the field trial assessment were 98.33%, which is also classified as very feasible. It means that the students gain a better learning experience overall. In fact, there was an increase in students' learning outcomes too, which was known by comparing the average pretest and posttest results of 46 and 85. The average improvement of student learning outcomes is 2.6 with high media effectiveness. From this research, researchers conclude that a virtual laboratory as a virus learning media can improve the learning outcomes of grade 10 students at SMA Singapore National Academy in biology subjects.

KEYWORDS: Virtual Laboratory, Virus Material, Learning Outcomes

I. INTRODUCTION

Biology is a branch of science that studies natural phenomena through observation, experimentation, and rational analysis to produce facts and concepts through the scientific method. The steps include making observations, formulating questions, formulating hypotheses, conducting experiments, and drawing conclusions. Biology is not only the mastery of some knowledge in the form of facts, concepts, or principles, but also a process of discovery. In the biology learning process, students are expected to play an active role during the learning process so that the scientific method, which is a process to produce biological products, can be implemented.

One of the biological materials is about viruses. The virus is contextual material because learning links the subject matter with everyday life. Students are required to find and develop new knowledge and skills in accordance with the knowledge they have. Students, on the other hand, do not know without a guide. It is difficult if teachers have to bring in a concrete form of the material itself. For this reason, the presentation of this material requires media. Thus, students will better understand and interpret their knowledge. During the process of science activities, the existence of a laboratory is very important, so biology teachers should invite students to carry out learning activities in the laboratory. However, the problem that occurs is that at this time, students are required to study from home due to the spread of COVID-19 during this pandemic. So that practicum in the laboratory will never be carried out. In addition, there are also things to keep in mind when working in the lab that could lead to accidents.

Another problem that arises based on the results of interviews at the Singapore National Academy High School is that student learning outcomes are still quite low, especially on virus material, which is below the minimum score standard (KKM) of 75. This is because the material is abstract, so students find it difficult to understand. And the learning activities of virus materials are limited to the explanation of concepts.

The solution that can be applied to overcome these problems is to apply learning media. Learning media are tools used to demonstrate certain facts, concepts, principles, or procedures to make them appear more real (Kustandi, Cecep, and Darmawan, 2020). Aside from that, the media can also increase student motivation and learning outcomes (Hartini et al., 2019). A Virtual Laboratory is one of the media that can be used in learning biology. A Virtual Laboratory is an interactive medium that simulates

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activities in the laboratory as if the user is in an actual laboratory (Chairani et al., 2019). Besides that, the Virtual Laboratory can overcome problems in learning by simulating material that is difficult to put into practice, such as material with concepts and objects that are difficult to put into practice. Abstract (Chairani et al., 2019). Furthermore, the Virtual Laboratory can also attract students' attention so that it can improve student learning outcomes (Chairani et al., 2019).

Therefore, to help students learn biology, we need to make a Virtual Lab on Virus Material. This way, it can help students in class X at the Singapore National Academy High School improve their learning results.

II. RESEARCH METHODS

This research is a research and development (R&D) project that aims to develop a virtual laboratory media virus material to improve student learning outcomes. This research was conducted at the Singapore National Academy Senior High School and the subjects of the research trial were content, design, media, peer and peer expert trials, and trials with 31 students.

The research development design used 4D development model consisting of four stages:

1. define,
2. design,
3. develop, and
4. disseminate

The definition stage consists of: (a) early-late analysis; (b) student character analysis; (c) concept and material analysis; (d) task analysis; and (e) specification of learning objectives. In this first stage, the defining activity is carried out based on the existing curriculum and student character. The virus material was chosen on the grounds that this material is abstract and difficult for students to understand.

The design stage consists of three things: (a) media selection, (b) format selection, and (c) initial design. The development stage includes the following stages: (a) expert validation; (b) revision; (c) limited trial; (d) revision based on limited trial; and (e) field trial. The disseminate stage is carried out by distributing the product to educators at MGMP Surabaya as users.

Data were gathered through interview activities, the distribution of questionnaires, media validation, the distribution of readability and difficulty level questionnaires, student response questionnaires, and learning outcomes, specifically the pretest and posttest.

III. RESULTS AND DISCUSSION

This research and development produces a decent and attractive virtual laboratory and is more likely to be applied as a medium of learning virus material. The product has been validated by material experts, media experts, peer teachers and get tested for the students.



Image 1. Virtual Laboratory Screenshot

The researcher also produces guidance module for teachers willing to make or use this media perfectly in classroom. This module provides complete guidance on how to make this learning media, how to use this media for Grade 10 students, and how to assess student performance afterward.

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Image 2. Virtual laboratory Teacher’s Guide

The instruments used in this study were research sheets on my feasibility of learning as learning media. The opinions are compiled to determine the feasibility and minor of learning media developed. The learning media was assessed by material experts, media experts, Grade V elementary school teachers. The researcher also collects responses from students. Score of all aspects in the research sheet was made using the Likert scale:

Table 1. Likert Scale

Score	Criteria
5	Very Good
4	Good
3	Fair
2	Unsufficient
1	Very Unsufficient

The results of the questionnaire test calculation are then set by referring to the validation criteria table or the level of achievement used in the percentage of validation in the following table:

Table 2. Feasibility Level Scale

Score	Percentage Scale	Feasibility Level
5	80%-100%	Very Feasible
4	60%-79 %	Feasible
3	40%-59 %	Fair
2	20%-39 %	Not Feasible
1	0%-20 %	Very Unfeasible

Based on the research data described previously, the virtual laboratory media obtained a 100% achievement rate percentage from content experts. From media design experts, the percentage of achievement level is 87.14%, far from the maximum percentage of 100%. From the media experts, the percentage of the achievement level was 84.28%, down from 100%. Meanwhile, peers get a percentage rate of 96.67% instead of 100%. And 98.83% was obtained from student responses of 100%. This shows that the virtual laboratory medium is very valid to be used as a medium in the biological learning process of virus material. More details on the results of the overall assessment can be seen in the following table:

Table 3. Product Assessment Results

Respondednt	Feasibility Score	Feasibility Level
Material Expert	100 %	Very Feasible
Design Expert	87.14 %	Very Feasible
Media Expert	84,28 %	Very Feasible
Peer Teachers	96,67 %	Very Feasible
Students	98,33 %	Very Feasible

As for the diagram of the overall assessment results can be seen in the following figure:

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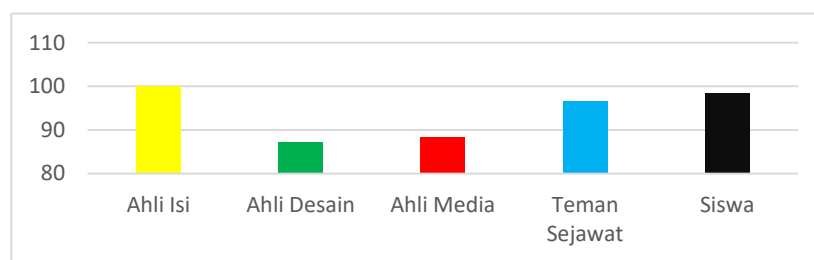


Figure 1. Assessment Results Visual Diagram

The student learning outcomes increase can be seen through the results of the n-gain calculation, which can be seen in table 4.

Table 4. Student's Score Increase

Pretest	Posttest	N-Gain	Category
46	85	2,6	Very Effective

Based on the table above, it can be seen that the average value of student learning outcomes before using the virus material virtual laboratory media (pretest) is 46 while the average value of student learning outcomes after using the virus material virtual laboratory media (posttest) is 85. The average increase in learning outcomes students are 2.6 with high media effectiveness.

The mean pretest score was 46; while the average posttest score was 85 with a difference of 39 and Normalized Gain reached 2.6 with high criteria. Normalized Gain shows an increase in the average score of students' cognitive learning outcomes before and after using the Virtual Laboratory on Virus material.

Based on the results that have been obtained, it shows that the Virtual Laboratory media is effectively used in learning activities. This media is able to improve student learning outcomes in the cognitive domain as previous research which revealed that the Virtual Laboratory can significantly increase the independence of laboratory work and students' mastery of concepts through the presence of ICT in the classroom (Herga, 2019).

IV. CONCLUSIONS

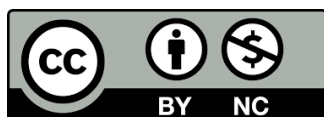
Based on the research that has been done, it can be concluded that the virtual laboratory virus material developed by the researcher shows that it is feasible to use and can improve student learning outcomes. And to improve research results, the authors give some suggestions, namely, developing a virtual laboratory as an android application. The virtual laboratory learning media developed in this study is recommended to be used for different classes and schools in learning biology material on viruses, Ideas and innovations in making virtual laboratory learning media developed in this study can be adapted to develop learning media on other materials. Furthermore, the virtual laboratory learning media developed in this study can be used in other classes and schools to teach other science subjects.

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