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Hydroponics Virtual Laboratory as An Innovation in Online Learning Media During A Pandemic

Sondra Swestyani [1,*], Ayu Novita Ramadhani [2]

Biology Tadris Study Program, IAIN Palangka Raya, Palangka Raya-Indonesia
[1] sondra.swestyani@iain-palangkaraya.ac.id; [2] ayunovitaramadhani28@gmail.com
* Corresponding author: sondra.swestyani@iain-palangkaraya.ac.id

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ABSTRACT

The Covid-19 pandemic has limited the role of laboratories in learning. Innovation in learning needs to be done, one of which is by using a virtual laboratory as a learning medium. This descriptive mix-method research aims to describe students' activeness in online learning and the practicality of virtual laboratory learning media developed as learning media. This research was a dissemination stage of the 4-D development research. The instrument was observation sheets on the students' activeness in online learning when using the hydroponic virtual laboratory. The results concluded that students' activeness increased by an average of 22.2% after using a hydroponic virtual laboratory. The virtual laboratory was practical as shown by 73.9% of respondents agreeing and 22.9% of them strongly agree.

Keywords: Virtual laboratory, Hydoponic, Online learning

Introduction

Hydroponics is the cultivation of the plant in a nutrient solution without soil. The IAIN Palangka Raya Biology Tadris study program has a graduate profile, one of which is an entrepreneur who can master biology science in entrepreneurship. Therefore, the IAIN Palangka Raya Biology Tadris study program provides facilities for a research group to study Hydroponics. The students are expected not only to master plant science but also techniques in hydroponic cultivation.

The Covid-19 pandemic had enormous impacts on learning (Strielkowski, 2020). It requires educators to be creative in delivering hydroponics topics. The government has limited face-to-face meetings and continues to follow health protocols in the learning process.

These conditions made it impossible to conduct a hydroponic practicum. Distance learning made hydroponic practicum cannot be carried out. On the other hand, this practicum cannot be eliminated casually due to the nature of the topic. These conditions caused students' activeness and understanding of hydroponics not to be optimal. Students become passive in online learning. They listen more but did not understand the concepts and cannot practice the hydroponic. This underlines the need for proper learning media for learning hydroponic learning in covid-19 pandemic conditions.

Restrictions on face-to-face meetings cause several obstacles in the learning process. Hydroponics, which should be an interesting topic with engaging hands-on activities becomes passive learning because educators cannot supervise directly and provide proper stimuli and activities. This is one of the considerations in determining learning media that can boost students' activeness in online learning.

In designing media to boost activeness in online learning, some consideration must be taken. For example, internet connection on students side. Educators must choose practical learning media that can be adapted to the current constraints in students' internet connection.

The ICT has spurred innovations to integrate technology with education to improve the quality of education (Rahmani et al., 2017). Efforts to integrate the ICT into online practicum can be achieved using a virtual laboratory (Dwiningsih et al., 2018). Based on the idea that contributions to meaningful learning because information technology provides an alternative learning environment (Gambari et.al., 2018). The proof is shown by increased in students' the mastery of knowledge (Darby-White et al., 2019), and able to improve the thinking skills of students (Widowati et.al., 2017). Therefore, the development of virtual laboratories is important to do to optimize online learning.

The virtual laboratory is created as a learning medium for hydroponic practicum. It was designed to be operated without constant internet connection. A virtual laboratory makes students more confident and comfortable in doing a practicum. It also boosts their learning motivation (Tatli & Ayas, 2013). This study wants to describe the students' activeness in online learning and the practicality of virtual laboratories as learning media.

Methods

This was a qualitative quantitative (Arikunto, 2017) research to evaluate the product from the previous development of learning media by researchers. This was a continuation of R&D (Pluye & Hong 2014) that has reached the Dissemination stage to evaluate products based on the students' activeness and its practicality as learning media.

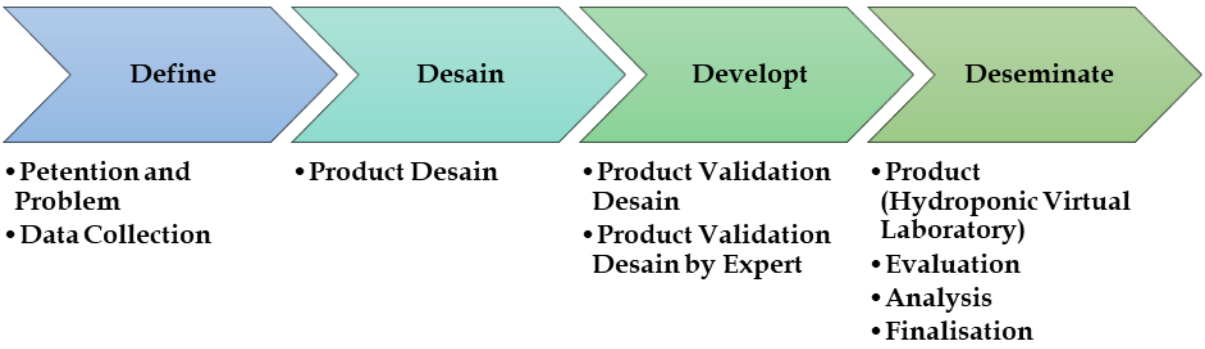


Figure 1. Development Process of the Hydroponics Virtual Laboratory.

Learning activity is defined based on both physical and psychic parameters (Asyhariyah, 2018; Suharni, 2021). In this study, four aspects were derived into indicators in assessing the students' activeness. The attention was indicated by (1) paying attention to the camera, and (2) being serious in participating. The aspect of bringing up the problem was derived into two indicators. The problem-solving aspect was derived into two indicators. The cooperation was derived into two indicators. Thus, there are eight indicators for measuring the students' activeness.

Practicality is one of the three criteria for assessing learning media (Wahyuni et.al., 2022). Four aspects which included appearance, convenience, learning and material was used as the criteria. These four aspects were derived into several indicators so that there are 10 indicators were used to assess the practicality of a hydroponic virtual laboratory in online learning.

The research sample (N = 31) included students who take part in the Hydroponics Study Group of the IAIN Palangka Raya Biology Tadris Study Program. Data were collected using two types of instruments: 1) observation sheets for students' activity; 2) a questionnaire with a four-point Likert scale to collect data related to the practicality of the Hydroponic Virtual Laboratory. The data were quantitatively analyzed to be described using percentages to be discussed qualitatively.

The percentages were calculated using the Equation (1). Xf showed observation results after using a hydroponics virtual laboratory in online learning. Xi showed observations before using a hydroponics virtual laboratory in online learning. N was the number of samples in the study.

$$Percentage\ of\ Students'Activeness\ Improvement = \frac{(X_f)-(X_i)}{N} \quad \text{..... Equation (1)}$$

Results and Discussion

The hydroponic virtual laboratory is a flash animation that can run only on a Windows or Mac. There are operational instructions to be used by users. This hydroponic virtual laboratory is a simple animation and practicum simulation regarding plant cultivation techniques by hydroponics, has. swf format specifications, and can be run using adobe flash player. The hydroponic virtual laboratory is shown as shown in Figure 2 followed by an example of a hydroponic seeding simulation as shown in Figure 3.

Figure 2. Main Menu Display of Hydroponics Virtual Laboratory

Figure 3. Hydroponic Seeding Simulation

Observations found increased in every aspect of student activities. The results of the observations can be seen in Table 1.

Table 1. Students' Activeness in Online Learning

Aspect	Indicators	N of Students. Before	N of Students. After	% of Increases
Attention	A1. Camera is on.	7	20	41.9%
	A2. Give full attention in learning.	20	28	25.8%
Giving the Arguments or Ideas	A3. Respond to questions and instructions from teachers.	5	16	35.5%
	A4. Express opinions regarding the topic.	3	7	12.9%
Problem-Solving.	A5. Ask the lecturer about difficulties in learning.	3	9	19.4%
	A6. Search for literature to solve difficulties	0	5	16.1%
Cooperation	A7. Active in discussions.	20	28	25.8%
	A8. Respect the opinions of others when discussing.	31	31	0%
Averages				22.2%

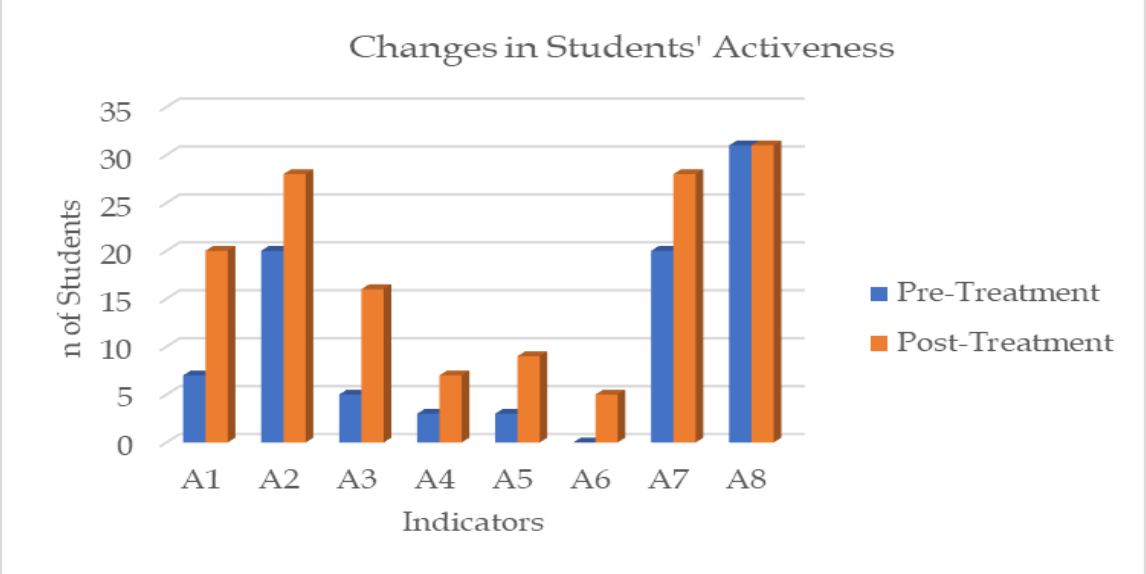


Figure 4. The Students' Activeness of When Using the Hydroponics virtual Laboratory in Online Learning

Results show that the hydroponic virtual laboratory learning media did not affect the students' activities related to respecting the opinions of others. However, the indicators related to activating the camera during online learning showed a very significant increase, which was 41.9%. This percentage was followed by activeness related to responding to questions and instructions which increased by 35.5%. This shows that the hydroponic virtual laboratory increased students' activities in online learning.

The analysis of students' activities shows increases in student learning activities from before and after the treatment. Practicums that utilize virtual laboratory makes students more confident and comfortable, so their motivation and activities increased (Dyrberg et.al., 2017). In all aspects, the students' activeness has increased except for the indicator of respecting other opinions. This is because students are trained to respect other opinions regarding what situations are.

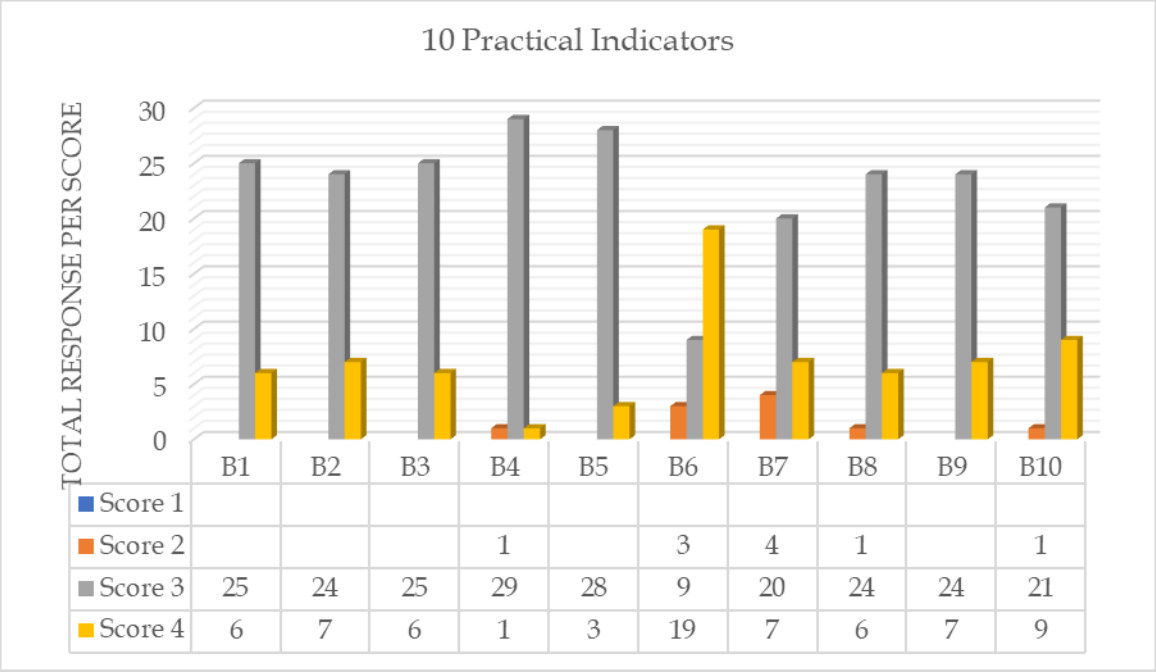
The practicality of the hydroponic virtual laboratory learning media was seen from the results of the practicality questionnaire analysis. The questionnaire was distributed to 31 students of the hydroponics study group. The results are shown in Table 2.

Table 2. Practicality of Hydroponics Virtual Laboratory Learning Media

Aspects	Indicators
Display	B1. Have clear manual (instruction for users).
	B2. The display of animations and images are engaging in delivering the topic.
	B3. Systematic topic delivery
Accessibility	B4. Easy to use.
	B5. User-friendly menus.
Pedagogical Quality	B6. Engaging content and promoting learning process.
	B7. Help to understand the topic.
	B8. Improving curiosity.
Topic Presentation	B9. Topics are easy to understand.
	B10. Topics and learning materials are complete.

Martinez-Jimenez et al. (2003) stated that virtual laboratories as an innovation in online learning media are proven to improve students' laboratory engineering skills. Woodfield et al. (2005) stated that the increase in learning activities when using virtual laboratories was due to students becoming more familiar with practicum procedures. This makes practicum more time-efficient (Jong, 2013), and students also become more focused on developing higher-order thinking skills. Without a detailed understanding of the procedure, students' activeness becomes low (Cann, 2016). Achutan & Murali (2015) suggested that virtual laboratories allow students to

repeat simulations if they have not yet understood, thus helping their learning process (Nolen & Koretsky, 2018).



	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Score 1										
Score 2				1		3	4	1		1
Score 3	25	24	25	29	28	9	20	24	24	21
Score 4	6	7	6	1	3	19	7	6	7	9

Figure 5. Practicality of Hydroponics Virtual Laboratory as a Learning Medium

Figure 5 shows that there are five indicators that some students were to disagree with. Those indicators are B4, B6, B7, B8, and B10. However, B6 gained the most agree response.

The improvement of students' understanding is helped by video (Mitra et al., 2010), thus shows that animated videos in learning is feasible and effective (Arthur et al., 2019). Hydroponic virtual laboratory learning media is equipped with images, videos, and animations that can help students understand hydroponic. These results also showed by the responses regarding the indicators B2, B6, and B10. B2 got 24 agrees and seven strongly agree. B6 got 19 respondents agreeing. B10 got nine respondents strongly agreeing, and two agreeing. But one respondent showed disagreement toward B10.

In general, the media got the following results for practicality: 0% strongly disagreed, 6.5% disagreed, 73.9% agreed, and 22.9% strongly agreed. These results show that the hydroponic virtual laboratory was practical to be used as learning media. However, there is still a response with the disapproval category, which show minor revisions are needed.

Conclusion

Student activeness is increased by an average of 22.2% after using a hydroponic virtual laboratory. The virtual laboratory got following results for practicality questionnaire: 0% strongly disagreed, 6.5% disagreed, 73.9% agreed, and 22.9% strongly agreed. The virtual hydroponics laboratory can be recommended as an online learning medium. However, minor revisions stiillebe required to ensure its quality.

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