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Technology Empowerment in Learning: Student Perspective Study on Virtual Laboratory to Support Independent Learning in Independent Campus

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Abstract.
Virtual laboratory is one of the solutions that can be used for practical or experimental activities in the context of independent learning on an independent campus, which is carried out outside the laboratory, especially during the Covid-19 pandemic. However, in practice, there are several obstacles so the use of virtual laboratories has not been massive. This study aims to analyze the student's perspective on the virtual laboratory in forcing conditions during the Covid-19 pandemic. The research method uses a survey with a questionnaire technique to capture the perspectives of students of the Biology Education Study Program at one of the universities in West Java. The perspectives studied include innovation, urgency, usefulness, and motivation which are grouped into positive and negative perspectives. The results showed that most of the students had a positive perspective on the virtual laboratory by 81.64%, and a negative perspective of 18.36%. Among the four indicators, motivation is the smallest positive perspective although it is larger than the negative perspective. This research can give the conclusion that the virtual laboratory needs to be continuously developed along with the improvement of students' technological skills or literacy.

Keywords: technology empowerment, student perspective study, virtual laboratory, independent learning

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1. INTRODUCTION

The purpose of the practicum or experiment can be achieved properly if the supporting facilities can meet all standard requirements. Practicum activities require various types of support facilities, infrastructure, and teaching skills to realize the theory that will be taught to students [1]. The laboratory has an important function in active practical learning. Laboratory practice allows for effective, permanent and fun learning [2].

The independent learning program aims to provide flexibility for students to study outside campus. One of them is online learning support that approaches offline learning. The Ministry of Education and Culture (Kemendikbud) issued Circular Letter Number 15 of 2020 concerning Guidelines for the Implementation of Home Learning (WFH) in the emergency period of the Covid-19 pandemic. The circular letter is to ensure the fulfillment of the rights of students to obtain educational services during the Covid-19 pandemic, protect education unit residents from the adverse effects of Covid-19, prevent the spread and transmission of Covid-19 and ensure the fulfillment of psychosocial support for educators, students, and parents. Based on these regulations, practical learning cannot be carried out in the laboratory. This is a challenge for teachers to be able to realize the concept of independent learning and still be able to carry out learning outside the real laboratory. The next problem is how to enable learning to be carried out effectively, permanently and pleasantly without the presence of a laboratory.

The above problems require the existence of a virtual laboratory that can facilitate practical activities with various virtual facilities, tools, and materials. A virtual laboratory is a web-based application to facilitate experimental practicum learning, so that students can learn independently, actively, interactively, and flexibly [3]. A virtual laboratory is an online learning environment that combines web-based resources, for interactive activities, educational videos, and learning methodologies [4]. A study shows the use of virtual laboratories is very efficient and fun. The virtual laboratory experience has a positive influence on students' attitudes, and shows a positive response to the virtual laboratory experience [5].

The use of virtual laboratories in dynamic visualization roles can increase knowledge and promote effective learning. Dynamic models and animations enabled by virtual laboratories are proven to be better when compared to static sub-micro presentations [6]. Research are a web-based virtual laboratory that can manage practicums in large volumes of biological time series sensor data while supporting fast data requests and real-time user interaction. The diagnostic sensors owned by the virtual laboratory use the cloud and advanced web-based storage technology to efficiently collect, analyze, and visualize data [7].

Based on the explanation above, the development of a virtual laboratory is a good solution to be used in the independent learning program for independent campuses during the covid-19 pandemic, so that there will be no vacum for practicum even though it is carried out outside the campus. This study aims to review the student's perspective on the Virtual Laboratory in facilitating practicum to supporting independent learning in an independent campus.

2. METHOD

The research method uses a survey method with a questionnaire technique to Biology Education students at one of the universities in Bandung total of 47 students from 4 (four) batches. The virtual laboratory sampled includes the contents of plant structures, animal structures and microbiology, with complete preparations, microscopes, cell measuring devices, communication rooms, and report development. The questionnaire aims to measure students' perspectives on the use of virtual laboratories in practicum. The questionnaire indicators cover aspects of innovation, urgency, usefulness, and motivation with positive and negative statements. The perspective qualification uses 4 (four) categories, consists of strongly agree, agree, almost agree, and disagree with the Likert scale. The proportion of the components of the questionnaire can be determined as in Table 1.

TABLE 1: Indicators of student perspectives on virtual laboratory.

Aspect	Statement		Number of Items	Sequence Number
	Positive	Negative		
Innovation	1	1	2	1,2
Urgency	2	0	2	3,4
Usefulness	4	0	4	5,6,7,8
Motivation	1	1	2	9,10
Total	8	2	10	

The perspective score of each indicator is stated on a scale of 1 to 4 with the category of positive are strongly agree = 4, agree = 3, almost agree = 2, and disagree = 1. While for negative statements are the opposite, strongly agree = 1, agree = 2, almost agree = 3, and disagree = 4. Furthermore, each score that is the same is added up and transformed into a percentage with the equation (1).

$$P = \frac{S}{N} \; x \; 100$$

P = Percentage of each scale (%)

S = Number of the same score

N = Number of respondents

3. RESULT AND DISCUSSION

Virtual Laboratory is an application for laboratory activities that are used online equipped with virtual practicum equipment facilities. Analysis of students' perspectives on the

use of virtual laboratories was carried out based on the results of the analysis of the questionnaire scores that had been processed in general, as shown in Figure 1.

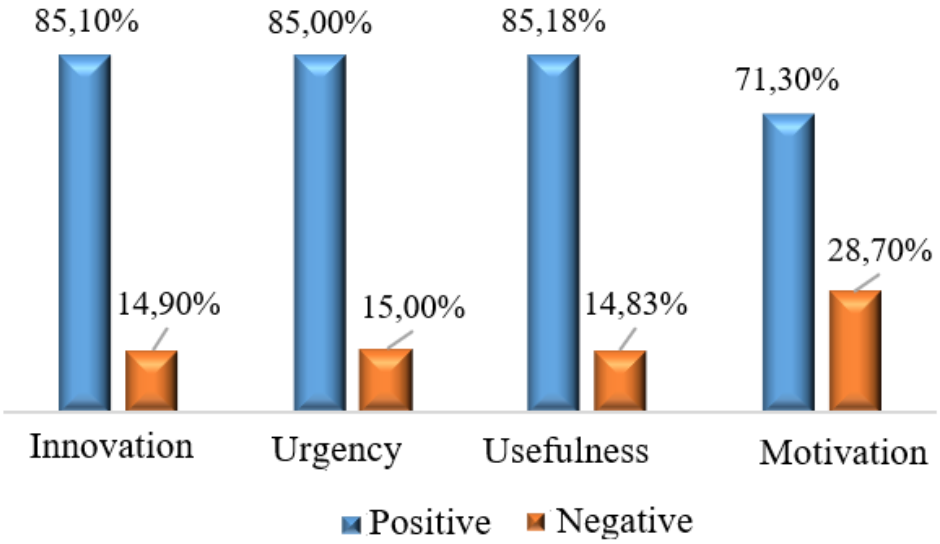

Figure 1: Student perspective on virtual laboratory.

Based on Figure 1, it can be seen that most students have a positive perspective on the virtual laboratory, which is approximately 81.64%, and 18.36% of students have a negative perspective. This shows that most of the students have logical and realistic awareness that empowering technology is important, especially in the conditions of the covid-19 pandemic where visits to real laboratories cannot be carried out. The positive perspectives of students then become a challenge, especially for lecturers and institutions to always facilitate the development of virtual laboratories [8].

Motivation is the aspect with the smallest perspective which is more influenced by the personal aspects of the students themselves. However, based on the deepening, in practice there are some disturbances to the personal devices used, such as internet access, loading time, and clarity of observation due to light. This makes the process of the practicum stages not run smoothly which results in its own disappointment and reduces the motivation for the implementation of the practicum. The following is a description and discussion of the findings of the student's perspective on the virtual laboratory in terms of aspects.

3.1. Innovation Aspect

The findings of the innovation aspect from the student's perspective on the virtual laboratory with consists of the student's knowledge of the virtual laboratory and the student's ability to use it. The data can be seen in Table 2.

Table 2: Virtual laboratory innovation aspect perspective.

No.	Aspects of Innovation	Positive	Negative
1	Get to know Virtual Laboratory before	85.10%	14.90%
2	Convenience of using Virtual Laboratory	85.10%	14.90%

Students who have a high perspective in both components of innovation is positive as much as much 85.1%. Students who have a negative perspective are 14.9% who stated that the virtual laboratory is a new thing for practicum activities so they had doubts about being able to run successfully. This finding means that *Virtual Laboratory* is an innovation in practicum that they want to do, thus providing freedom in learning. This is in line with the concept of independent learning initiated by the Ministry of Education and Culture [8].

The student's perspective so far is that practicum activities are only carried out in a physical laboratory room. However, the fact is that practicum can be done off-campus online or blended learning, so most of them have a positive perspective on virtual laboratories. Most undergraduate and master's students rate positively the presence of a virtual laboratory in learning because it can improve the learning experience. In addition, in a limited trial of the virtual laboratory he developed found that teachers and students gave good responses to aspects of content suitability and ease of use, and concluded that the developed virtual laboratory has high validity and is suitable for use in learning [9].

3.2. Urgency Aspect

Finding the urgency aspect from the student's perspective on the virtual laboratory which includes the urgent need for the virtual laboratory and conformity to the needs. The data on the urgency aspect can be seen in Table 3.

Table 3: Aspects of the urgency of the virtual laboratory.

No.	Urgency Aspect	Positive	Negative
1	Urgent Needs	83.00%	17.00%
2	Conformity to needs	87.00%	13.00%

In online learning, an average of 85% of students have a positive perspective that virtual laboratories are needed to facilitate practicum. While 15% of students' perspectives were negative that there was no need for a virtual laboratory, because they thought it would not be able to facilitate practicum properly. Most students think the virtual

laboratory as an urgent need to support independent learning, especially during this Covid-19 pandemic. Most students consider that virtual laboratories facilitate practical learning and can investigate on their own, and as an excellent preparation tool for real experiments [3]. Virtual science laboratories can lead to understanding science lessons more easily and allow them to conduct experiments in a shorter time, and encourage them to make further new experiments with curiosity [10].

3.3. Usability Aspect

The findings of the usefulness aspect of the virtual laboratory in facilitating practicum in the Covid-19 pandemic, namely training operational and visualization skills, increasing observation, increasing responsibility, and improving students' social communication skills. The data on the urgency aspect can be seen in Table 4.

Table 4: Aspects of the use of virtual laboratory.

No.	Benefit Aspect	Positive	Negative
1	Training Operational and Visualization Skills	87.20%	12.80%
2	Improve observation	91.50%	8.50%
3	Increase responsibility	88.00%	12.00%
4	Improve social communication skills	74.00%	26.00%

Virtual laboratories have virtual devices that can also be combined with real devices to make observations that are closer to realistic. The virtual laboratory also has virtual labeling tools, measuring object observations, online practicum report forms, and online communication rooms. From Table 4, it can be seen that the majority of students with an average of 85.2% have a positive perspective that virtual laboratories can train students' intelligence in operating technological devices, visualizing objects of observation, identifying, analyzing objects of observation, practicing language and interpersonal intelligence. It also shows that most students think that the virtual virtual laboratory is a useful aspect in facilitating the practicum learning system.

As the results of research that virtual laboratories have many significant advantages [6]. The results of the didactic experiment show that in terms of acquiring knowledge, using a virtual laboratory is better than a class that does not use it. Virlab had a proportional effect on knowledge, skills, attitudes, achievements, involvement, motivation and innovation [11]. The developed virtual lab can be used to improve analytical thinking skills and evaluate the ability to carry out science projects for high school students [10]. The virtual laboratory experience has a positive effect on students' attitudes. In addition,

the semi-structured interviews determined that they had a positive opinion about the virtual physics laboratory experience [5].

3.4. Motivational Aspect

The findings of the motivational aspect of the virtual laboratory in facilitating practicum in the Covid-19 pandemic condition, namely increasing student motivation in studying with practicum, and students being able to solve problems in implementing practicum learning outside the campus laboratory. The data on these aspects can be seen in Table 5.

TABLE 5: Motivational aspects of virtual laboratory.

No.	Motivational Aspect	Positive	Negative
1	Increase Motivation	85.10%	14.90%
2	Implementation constraints	42.50%	57.50%

The motivation aspect has the lowest perspective among all aspects, namely 71.3%, but it is strongly influenced by operational technicalities which is very low, namely 42.50%, while self-motivation has a good perspective and is almost uniform with other aspects, namely 85.10%. This shows that most of the students have a positive perspective that virtual laboratories can increase the motivation for practicum implementation. Biology teachers and prospective biology teachers are equally motivated by hands-on activities and virtual dissection on the subject of Anatomy [12]. Virlab has a proportional effect on knowledge, skills, attitudes, achievement, involvement, motivation, and innovation [11]. The low positive perspective of the motivational aspect is caused by obstacles in implementation. Several things that have a relationship with obstacles include access, compatibility, and literacy. The access is the internet which is influenced by the availability of infrastructure, geographical location, and devices. Compatibility is the suitability of technological devices used primarily for supporting content types and characters. Literacy is an operational skill needed to run applications, and understanding business processes [13].

4. CONCLUSION

Based on the stages and results of data analysis, it can be concluded that virtual laboratories for online practicums generally get a good positive perspective based on aspects of innovation, urgency, usefulness, and motivation. The aspect that is

still low is motivation which is specifically due to operational technical constraints. These results indicate that students already have a perspective on the importance of technology empowerment to support practicum-based learning. Most of them believe that technology empowerment will be able to improve the quality of learning. Students still have doubts in the context of the implementation of obstacles or disturbances so that the implementation of the practicum does not go well and intact. To overcome this, it cannot be solved only by students, but other parties are needed, especially in building infrastructure, policies, and providing other supporting tools.

The aspect of innovation that needs to be improved is technological literacy or digital literacy which is largely determined by the readiness, commitment, and creativity of the students themselves.

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