

## ANALYSIS ON THE IMPLEMENTATION OF VIRTUAL VERSUS REALITY LABORATORY

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**Abstrak** – Pembelajaran kimia memiliki kegiatan pembelajaran teori dan praktikum. Infrastruktur laboratorium merupakan bagian yang sering menjadi hambatan utama. Secara umum penelitian ini bertujuan untuk memberikan alternatif solusi pada keterbatasan sumberdaya pembelajaran di Perguruan Tinggi khususnya matakuliah praktikum, Secara khusus penelitian ini dilakukan untuk menganalisa pengaruh penerapan virtual laboratorium dan reality laboratorium dengan metode eksperimental yaitu 15 sampel mahasiswa Universitas Singaperbangsa Karawang diberikan praktikum secara virtual dan secara real di laboratorium, kemudian sampel mahasiswa menjawab 7 jenis pertanyaan untuk mengetahui pengaruh antara praktikum virtual dan real yang telah dilakukan. Hasil analisa dari jawaban sampel mahasiswa atas 7 jenis pertanyaan yang diajukan dapat disimpulkan sebagai berikut: penerapan virtual lab dapat mengurangi kesalahan dan kecelakaan kerja saat praktikum real dilaboratorium, selain itu penerapan virtual lab juga dapat menjadi solusi bagi perguruan tinggi yang memiliki permasalahan dengan fasilitas laboratorium, namun virtual lab tidak bisa diterapkan secara penuh menggantikan reality lab, hal ini dikarenakan tingkat pengalaman dan keterampilan praktikan dengan virtual lab tidak sebaik dengan reality lab. Praktikan tidak secara langsung berinteraksi dengan alat dan bahan kimia, sehingga virtual lab lebih efektif jika diterapkan sebagai praktikum pendahuluan untuk menunjang pemahaman praktikan dalam melakukan praktikum real di laboratorium.

**Kata kunci:** *Virtual Lab, Reality Lab, Praktikum*

**Abstract** – Chemistry learning involves theoretical education and practices. Laboratory infrastructure frequently becomes the primary obstacle. Generally, this research aims to provide an alternative solution for the limited learning resources in Universities, especially in practice courses. This research was specifically conducted to analyze the effect of the implementation of the virtual laboratory and reality laboratory through an experimental method. The research participants were 15 students from Singaperbangsa University Karawang. The participants were given seven questions to reveal the effects of a virtual and a real practice they had carried out. The analysis result on students' answers identifies that the implementation of virtual lab reduces mistakes and work accidents usually happen in the real laboratory, and it can be an alternative for universities with problems in their laboratory facility. However, the virtual lab cannot fully replace real laboratory, since the level of experiences and skills provided by the virtual lab is not as desirable as the real laboratory. The student does not directly interact with tools and chemicals, so the virtual lab is more effective if it is applied as a preliminary practicum to support the understanding of the practicum in conducting real practicum in the laboratory.

**Keywords:** *Virtual Lab, Reality Lab, Practicum*

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## **INTRODUCTION**

Chemistry learning combines theoretical education and practices. Thus, it requires both learning framework, as well as a learning media that supports the learning; especially, in the course of the practice, the allocated limited time for material explanation, the practices procedure guidance or the process of drawing the conclusion that affects the learning process and students' understanding level on the chemistry learning material (Hikmah et al., 2017).

This research was induced by practice activity that requires preliminary practice to curtail the possible mistakes jeopardizing safety and security in real practice (Mia, 2018). Besides, insufficient laboratory resources will no longer become an issue, and it also eases the lecturer to guide a more active practicum learning process (Jaya 2012). One of the learning materials with practice activity is acid-base material. Acid-base content belongs to one of the contextual concepts so that the practice activity becomes a stimulus for students in comprehending the acid-base concept (No 2012).

Laboratory infrastructure often becomes the primary hindrance. The procurement of infrastructure involves not only fund and energy, but also complex continual management, specifically for universities with limited resources (land, works, funds, and time). There are some things perceived as issues in laboratory management, including (1) laboratory resource that subsists of practicum equipment, technician/worker, lecturer as the supervisor, practicum assistant, and practicum place; (2) laboratory management that covers ways to manage the practicum time to ease the process, from the management and users (students) perspective; (3) practices fund that includes ways to minimize the budget spent without lessening the quality since the practice material price is continuously increasing; and (4) improving students' quality or competences with narrow laboratory sources (Setiawan et al., 2018).

In general, this study aims to discover the effect of the virtual reality laboratory implementation toward the real laboratory applied in the educational world. Individually, this research was carried out in an acid-base analysis practice course at Singaperbangsa University, Karawang. In this research, the virtual laboratory model was developed based on the Chemlab application that facilitates students to download the material and tutorial, as well as upload their complete tasks. The system enables the laboratory to open for 24 hours since the practices can be conducted online (Bintaro and Kusir 2018).

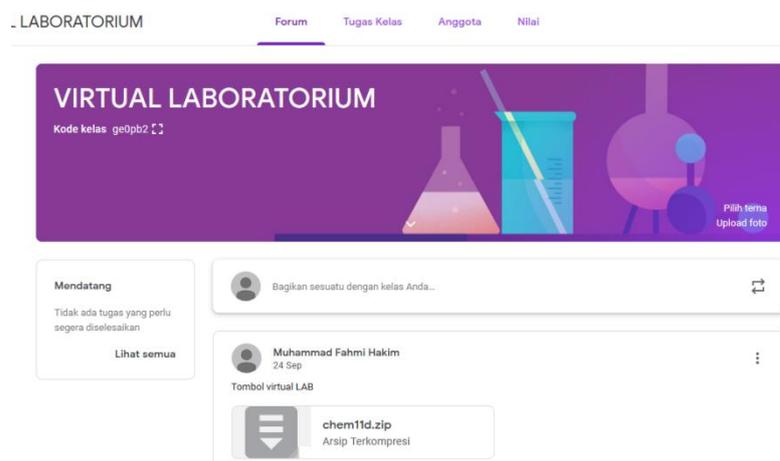
## **METHODS**

This research analyzes the implementation of virtual vs. real laboratory using the experimental method. Fifteen students were chosen as the research samples. These respondents had a double role, as the group had to complete an experiment in a virtual lab, and then they conducted another investigation in a real laboratory. They acted as a control group based on the experience and comprehension from the practices they had attended, as well as the control group that compares the effect of virtual laboratory toward the real laboratory.

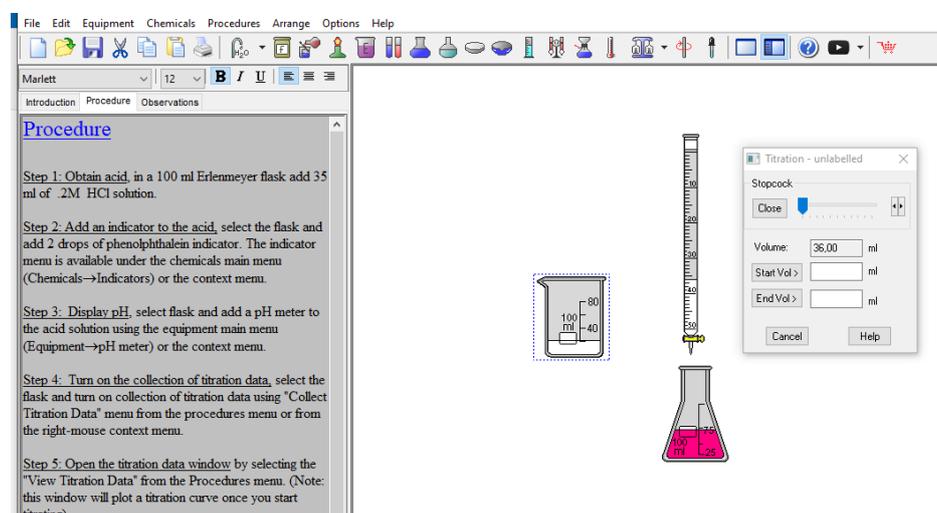
The data collection was carried out using a survey on the samples. The 15 participants were given seven questions in Google form, as presented in Table 1. In that survey, the students were asked to choose an answer from the five provided choices, subsisting of extremely disagree, disagree, not really agree, agree, and highly agree. The data analysis was completed based on the percentage of students' answers, mainly the answer with the highest rate. The virtual laboratory in this research was developed by collaborating Chemlab and Google Classroom software, as illustrated in Figures 1 and 2.

**Table 1. Survey Questions Given to The Research Participants**

No.	Questions
1	What is your opinion on the full implementation of a virtual laboratory to replace a real laboratory?
2	A virtual laboratory is a solution for the unavailability of a real laboratory facility.
3	What is your opinion on the implementation of a virtual lab in preliminary practices before practices in a real laboratory?
4	A virtual laboratory decreases the risks of mistakes and work accidents during the practicum.
5	Real laboratory requires a longer time, which makes it become less efficient and effective.
6	Understanding and experience attained from a virtual laboratory are better than a real laboratory.
7	Understanding and experience attained from the real laboratory are better than the virtual laboratory.



**Figure 1. Display of Google Classroom for Virtual Laboratory**



**Figure 2. Display of Software Chemlab with Acid-Base Titration Practice Sub-material**

## RESULTS AND DISCUSSION

This study was started by practice in a virtual laboratory by 15 students, then followed by practice activity in a real laboratory. The data were obtained through a survey of the participants, with seven questions. The results of that survey are discussed below.

### Question 1

What is your opinion on the full implementation of the virtual laboratory to replace the real laboratory?

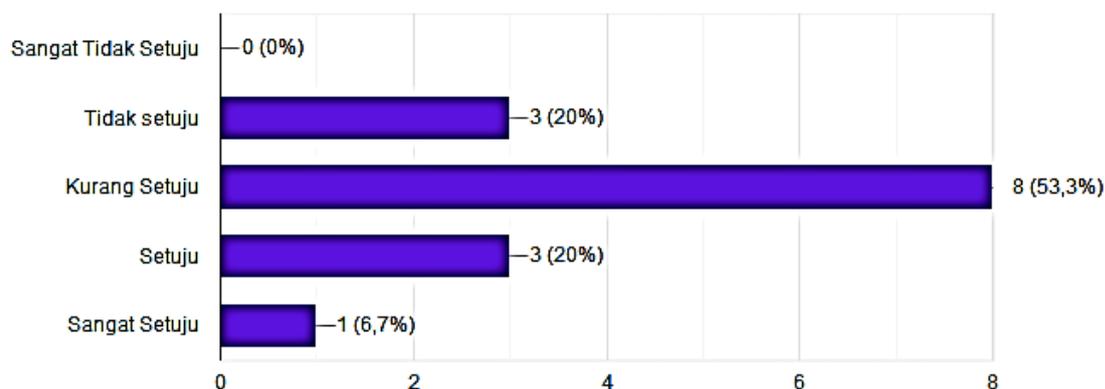


Figure 3. Diagram of Results for Question 1

The highest percentage answer chosen by the students is not really agreed, 53.3%. At the same time, a similar response also presented by 20% of students who chose to disagree. This is because most students presume that the practice activities conducted in the virtual laboratory are different from the ones they completed in a real laboratory, primarily on the students' motoric experience and skills perspective (Muzana et al., 2018). In contrast, 20% of students answered extremely agree, while 6.7% of students chose to agree since, in the current digital era, digital skills have sufficiently interpreted comprehension.

### Question 2

A virtual laboratory is a solution for the unavailability of a real laboratory facility.

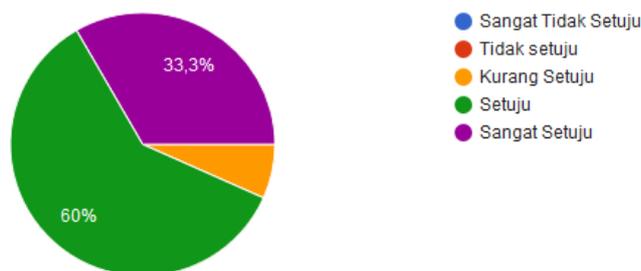
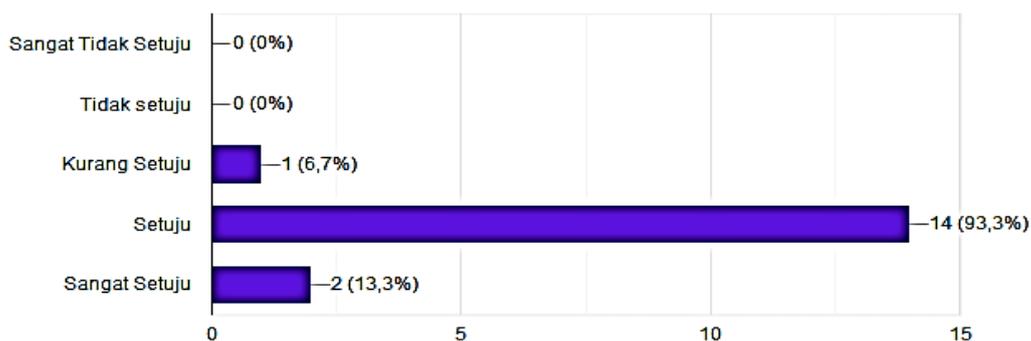


Figure 4. Diagram of Answers for Question 2

Figure 4 illustrates that the highest percentage answer of 60% chose to agree that a virtual laboratory becomes a solution to encounter the unavailability of the laboratory facility. The laboratory facility is the issue met by many universities. The system of waiting for equipment and material approval frequently collides with the course schedule; thus, it affects the practice activity in the real laboratory; therefore, the existence of this virtual laboratory is perceived as an alternative measure to solve this problem (Yuyun 2019).

### Question 3

What is your opinion on the implementation of a virtual laboratory in preliminary practices before the practices in a real laboratory?

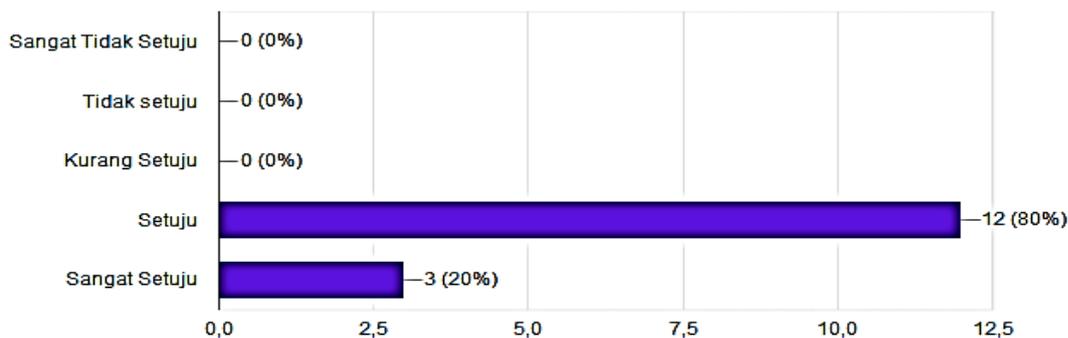


**Figure 5. Diagram of Results for Question 3**

Most of the respondents agreed that a virtual laboratory is used in preliminary practice before the practice in a real laboratory, 93.3%. In real laboratory practices, mistakes repeatedly made by students, such as mistakes in the procedure, material estimation, the use of equipment, even sometimes work accident occurs. Implementation of a virtual laboratory in preliminary practices is perceived as a solution to lower unexpected accidents.

**Question 4**

A virtual laboratory decreases the risks of mistakes and work accidents during the practicum.



**Figure 6. Diagram of Answer on Question 4**

Most of the respondents (80%) agreed that the implementation of a virtual laboratory depreciates the risks of mistakes and work accidents during the practice activities, even the remaining 20% of the respondents chose highly agree. This is in accordance with a study conducted by Mirdayanti (2017) that explains the implementation of a virtual laboratory accelerates the security and safety of the students during the practicum. This comes from their indirect interaction with chemical equipment and material.

**Question 5**

The real laboratory requires a longer time, which makes it become less efficient and effective.



**Figure 7. Diagram of Survey Results for Question 5**

Respondents' answer to this question is divided into two, with 20% of the difference. 60% of the respondents agree that reality laboratory practices require a longer time; thus, it becomes less effective and efficient. At the same time, 40% of respondents chose not really agree. The practices using reality laboratory involve time that corresponds to the procedure. However, the total needed time has been established based on the practicum guidelines book and adjusted to the semester credit unit for the practice course.

#### Question 6

Understanding and experience attained from the virtual laboratory are better than the real laboratory.

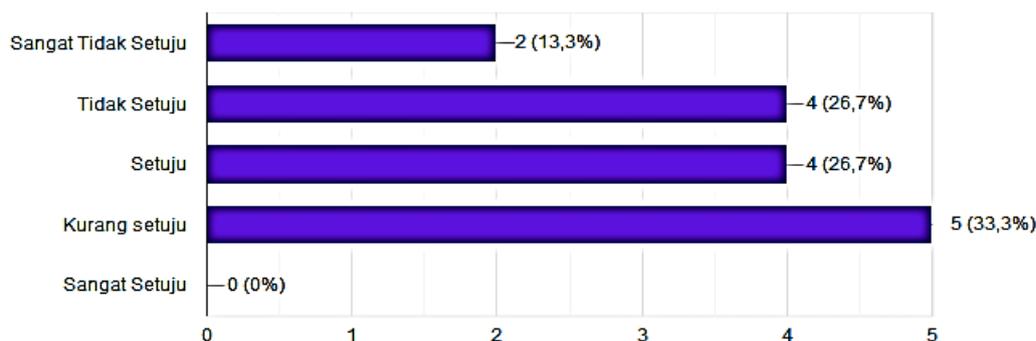


Figure 8. Diagram of Survey Results for Question 6

There are 33.3% of respondents chose not really agree that the comprehension and experience attained from the virtual laboratory is better than from the real laboratory. The non- authentic interaction using the equipment and material in the implementation of virtual laboratory minimizes the students' skills and experience, compared to the real laboratory (Sugihari et al. 2018).

#### Question 7

Understanding and experience attained from a real laboratory are better than the virtual laboratory.

53.3 % of the respondents agreed to the statement that the comprehension and experience attained from a real laboratory is better than from a virtual laboratory. Technically, the practicum in real laboratory accelerates students' understanding and knowledge. This comes from the students' motoric skills who directly carry the practice activities from the beginning until the end, along with all events that occur during that time, such as the problem-solving skills during the activities (Lutfi 2017).

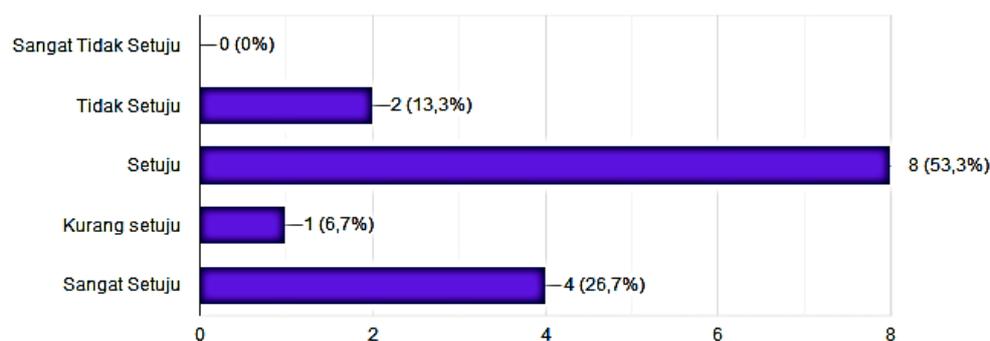


Figure 9. Diagram of Survey Results for Question 7

## CONCLUSIONS

In the analysis of the effect of virtual laboratory vs. real laboratory implementation toward 15 samples of students from Singaperbangsa University, Kerawang several results were obtained. First, the application of virtual laboratory before real laboratory highly supports students in conducting the practicum, starting from their better understanding of the practice procedure, minimize mistakes and work accidents during the practicum, and become the temporary alternative for universities with issues in the limited laboratory facility. However, the virtual laboratory can not fully replace real laboratory, since the level of students' understanding and skills obtained from the virtual laboratory are not as good as from real laboratory. Students' are provided by indirect interaction with chemicals equipment and materials in a virtual laboratory so that it becomes valid for the pre-practices or preliminary practices. The results of this research can be a reference for Singaperbangsa University, Karawang primarily, and all levels of education institutions, generally, in implementing virtual laboratory as their technical practice implementation that supports students' in conducting practices.

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