CHAPTER I
INTRODUCTION

1.1 Background

Society nowadays is already living in the fourth revolutionary era, commonly called industry 4.0. Society pivots from conventional manufacturing and industrial practices to modern innovative technology in this era. Following the revolutions of the industry, education revolutes as well into 'Education 4.0'. Puncreobutr (2016) said that on this Education 4.0, students are expected to be adjusted to the new technology. One of the methods for education 4.0 is by doing remote learning. Remote learning, sometimes, is roughly equated with various other terms such as e-learning, m-learning, and virtual classroom. Robinson et al. (2013) stated that e-learning, commonly known as educational technology, implements computers and technology to aid the learning of both theory and practice. Hallberg (2017) stated that many schools in developed countries, like the UK, South Korea, and China, and developing countries, such as India, have already implemented digitalization in their educational system.

Despite the rise of e-learning popularity, some education institutions have not fully implemented this digitalization of education due to the obstacle they faced during the implementation. The obstacles are (1) lack of security, on both execution and content-wise, (2) lack of teacher's internet experience, and (3) lack of infrastructure (Khoury et al., 2011). Indonesia has been implementing e-learning since the early 21st century. However, proper facilities such as internet connection still become a significant obstacle for implementing e-learning in Indonesia. Students' lack of awareness in the implementation of e-learning becomes one of the obstacles faced as well (Kusumo et al., 2012). The emergence of the COVID-19 pandemic boosts the popularity of e-learning. The possibility of the virus spreading in social gatherings causes educational institutions to interchange conventional education with e-learning. This virtual laboratory activity appears useful during distance/remote education and can also be done during offline classes to avoid the risk that can be gained during traditional laboratory activity.

Virtual laboratory activity is claimed to be exciting and motivate students to do discovery activities and strengthen their skills. Virtual laboratory activity also provides students an opportunity to learn by doing (Gorghiu et al., 2009; Oidov et al., 2012). One of the virtual labs commonly used today is the PhET Interactive Simulations. Guttenplan (2011) reported that PhET Interactive Simulations is a project developed at the University of Colorado Boulder that provides an explorable explanation. It was founded in 2002 by Nobel Laureate Carl Wieman. PhET Interactive Simulations is quite popular, considering the simulations have been translated into over 65 different languages, and in 2011, the PhET website received over 25 million visitors.

PISA (Program for International Student Assessment) conducted a survey every three years on 15-year-old students. Ever since 2000/2001, Indonesia participates on PISA and science literacy is one of the domains in PISA. The test conducted by PISA aims to find out the extent to which students have understood the knowledge and skills essential for full participation in society. The assessment carried out focused on reading, math, and science skills. The results from PISA show that the skills and knowledge of Indonesian students in science are below the average and lower than the previous result (OECD, 2022). The characteristics of PISA is found to be similar to the characteristics of SPS Test Items (Rustaman, 2007).

A study done by Jeon & Park in 2014 emphasized on their study that students' scientific communication skills, which were known to have direct influences on students' achievements, have a correlation with and are influenced by students' performance and logic. Alkan (2016) claimed that implementing scientific methods developed using science process skills can lead to obtaining scientific knowledge. Therefore, the laboratory is vital for students' performance improvement. Jeon & Park (2014) also pointed out that science process skill is crucial to student's academic achievements. Laboratory activities have an important influence on assessing and developing students' science process skills. However, traditional laboratory has a pretty high level of risk, including laboratory activity for the 'Dynamic Electricity' topic, and the risk of the traditional laboratory cannot be neglected.

Learning Ohm's law and other electrical concept can be hard to carry out as Ohm's law is considered an abstract concept as the concept is difficult to be visualized directly. According to Gunawan et al. (2018), the learning of Ohm's law requires sufficient supporting experiments to be well explained to the students. Virtual laboratory is appropriate to support the learning of Ohm's Law as it will help students to visualize the microscopic representation of the concept directly. Students need to understand the concept, not only in microscopic level, but also the macroscopic and symbolic representation. While microscopic and symbolic representation, the real-life macroscopic representation of Ohm's law concept can be studied in traditional laboratory.

Combining virtual laboratory with traditional laboratory can become one of the solutions on improving students' science process skill in learning dynamic electricity, especially Ohm's law. However, there is not many research and source regarding this topic, especially on Indonesian students. Thus, in this research, researcher would like to find out whether combining virtual laboratory and traditional laboratory appear to be useful on improving students' science process skill by comparing students' science process skills between combined and traditional laboratory activities.

1.2 Research Problem

The research problem is "How is the comparison of students' science process skills between combined laboratory and traditional laboratory activities?" Specifying the research problem, this research pursues to delve into the following questions:

1) How are the comparison of students' science process skills between combined laboratory and traditional laboratory activities on each aspect?
2) Which science process skill aspect has the most contrast difference and least contrast difference by conducting combined laboratory and traditional laboratory.

1.3 Limitation of Problem

The limitation of this research is:

1) Combined laboratory

   Virtual laboratory used in this research is PhET Simulation 'Circuit Simulation Kit: DC.'

2) Dynamic Electricity

   This research's topic scope is limited to dynamic electricity in grade 9. The topic is focused on core competencies 3 and 4 and basic competencies 3.5 and 4.5, which refer to the 2013 Indonesian National Curriculum for Junior High School. The sub-topic is limited to Ohm's Law topic.

1.4 Research Objectives

The objective of this research is adjusted to the research problem and focuses on the following objective:

1) To analyze the comparison of students' science process skills between combined laboratory and traditional laboratory activities on each aspect.
2) To analyze which science process skill aspect has most contrast difference and least contrast difference by conducting through combined laboratory and traditional laboratory.

1.5 Research Benefit

The results of this study are expected to provide the following benefits:

1) Students, results of this study are expected to encourage students to explore virtual laboratories for their learning activity.
2) Teachers, results of this study are expected to become teachers' reference in choosing which method is more appropriate in their learning activity to improve students' science process skills.
3) Researchers, results of this study are expected as a reference and additional exposure in using virtual laboratories as a learning media to improve students' science process skills.

1.6 Organization of Research Paper

Chapter I: Introduction

The first chapter is the introduction. In this chapter, several points were explained, such as the background of this research, the research problem and question, the research limitation, the research objective, the research benefit, and the research paper organization.

Chapter II: Literature Review

The second chapter is the literature review which is in this chapter contains the theory of the research variable. It begins with the explanation of virtual laboratory, PhET Simulation, students' science process skills, until the explanation of dynamic electricity topic.

Chapter III: Methodology

The third chapter is about research methodology where this chapter consists of the research method and design, population and sampling, operational definition, hypothesis and assumption, research instrument, data analysis, and the procedure of this research.

Chapter IV: Result and Discussion

The fourth chapter discusses the findings of this study's data analysis. It consists of recapitulation, calculation, and data result explanation. This chapter contains all the answers to the research questions.

Chapter V: Conclusion, Implication and Recommendation

The fifth chapter concludes the information gathered in the previous chapter. This chapter also provides the author's recommendation for further research