

CHAPTER I

PREELIMINARY

1.1 Background of Research

The exploitation of technological advances in education has become a trend, rapid advances in Information and Communication Technology (ICT) and the ever-increasing internet access use go hand in hand to provide new educational tools both for educators and students (Sypsas & Kalles, 2018; Zawacki-Richter & Latchem, 2018). The trend of using technology, such as the use of virtual concepts, has become a thing in delivering computer-generated virtual reality simulation (Boulton, Kent, & Williams, 2018; Radianti, Majchrzak, Fromm, & Wohlgenannt, 2020). Because of that, the virtual concept has been described as a 21st-century learning tool and media and commonly known as virtual learning (Aulia Najiyah, Dwisandi, Nizar Maulana, & Hernawati, 2021; Hawkins & Phelps, 2013)

One of the ICT advances is simulation. Simulation is a tool to understand the artificial or natural system and explain its performance (Ramat & Preux, 2003 as cited on Sypsas & Kalles, 2018). Simulation is also used for increasing current systems or operations and offering a better understanding of a system, and potentially helping identify suggested improvements (Robinson, 2004). Due to the fact stated earlier, simulation has been adopted as an educational environment for experiments to help students comprehend and adopt real laboratory and skills (De Jong & Van Joolingen, 1998 as cited on Sypsas & Kalles, 2018) in the form of the virtual laboratory. A virtual laboratory is defined as an interactive environment for creating and conducting simulated experiments with a real sense of time and location (Muhajarah & Sulthon, 2020). It constitutes a special category of simulation and is based on models of physical laboratories and the experimental processes taking place therein (Rossiter, 2016)

Practicum is notable in biology learning activity. Practicum in the laboratory is essential in developing process and inquiry skills in students

(Widowati, Nurohman, & Setyowarno, 2017). Laboratory activities have many advantages for students in generating their learning motivation, developing experiment skills as a medium for learning scientific approaches, and supporting learning materials (Rustaman et al., 2005). Nonetheless, practicum in biology learning is often not carried out for various reasons, such as not having representative biology and limited tools and material to prepare experiments (Aripin & Suryaningsih, 2020). In addition, the Covid-19 pandemic situation made biology practicum activity cannot be held. It created a big uncertainty in research and education. Globally, a lot of practical sessions in academia have been suspended without any clear indication since 2020 (Vasiliadou, 2020)

Microbiology has been defined as the study of organisms and small agents to be seen clearly by the unaided eye or the study of microorganisms (Prescott, 2002). This study requires laboratory activities to acquire and develop practical skills that cannot be afforded through lectures and reading but can be obtained with a stimulating learning environment (Brockman, Taylor, Segars, Selke, & Taylor, 2020). One of the notable practicum activities in microbiology is bacteria staining. Bacteria staining practicum had to be done to facilitate microorganism cell shape observation, to measure the size of microorganisms, to observe the external and internal structure of microbial cells, and to classify bacteria based on their reaction towards dye given (Harley & Prescott, 2002).

Due to the closure of the laboratory, real laboratory-based discipline are significantly affected, suspended practicum activities for a long time, causing extreme stress for students (Vasiliadou, 2020). This statement is in accordance with the data obtained from the initial observation. Practicum is difficult to do during distance learning; only a few practicums can be carried out independently by students in their homes. Meanwhile, practicum must be carried out sequentially according to the lesson plan and requires laboratory equipment. Overcoming this obstacle, lecturers usually use learning videos to replace practicum activities. However, the use of learning videos as a substitute for practicum is considered less effective because students do not play a direct role in practicum activities and

several practicums cannot be covered using video learning media such as bacteria staining because it requires a lot of laboratory skills and equipment.

In the mean time, obstacles in pandemic situation is not main concern anymore since the regulations of social distancing has been revoked and reduced cases of Covid-19 pandemic in Indonesia. However, the presence of a virtual laboratory as one of many advances in educational technology has many benefits such as cost reduction, being harmless because free from the use of hazardous substances or materials, and being available to be accessed anytime and anywhere (Sypsas & Kalles, 2018). Students also perceive the accessibility and benefits of the virtual laboratory as more convenient and as effective as a hands-on laboratory (Brockman, Taylor, Segars, Selke, & Taylor, 2020).

However, despite these benefits of virtual laboratory, it still does not fulfill practical skills acquired in a physical laboratory through experience and continuous practice. Hands-on laboratories help students acquire haptic skills and instrumentation consciousness, which is difficult to achieve with a virtual laboratory (Abdulwahed & Nagy, 2013; Zacharia & Zacharia, 2015). On the other hand, the virtual laboratory has better aspects that can be repeated, minimized risk, and accessed anywhere (Stuckey-Mickell & Stuckey-Danner, 2007 as cited on Aripin & Suryaningsih, 2020). Eventually, the virtual laboratory can support the use of physical laboratory as (1) a simulation model before direct practice, (2) a substitute for expensive and dangerous lab tools and materials, and (3) actual practicum activities (Sypsas & Kalles, 2018)

The development of interactive multimedia like virtual laboratory is one of the application of technology in learning and solution to face practicum problem in pandemic situation. There is three application that supports the development of the virtual laboratory. One of them is Adobe Animate CC, already known as an animation and multimedia software that provides various supportive features and can design interactive and light graphic vectors for video, websites, applications, and video games. Not only that, but also assisted with Figma as a cloud-based

design application and prototyping tool for digital projects to create interactive user-interface and Ibis Paint X to make the components of laboratory activities

Based on the background stated before, the necessity to create innovation on learning media in the form of the virtual laboratory should be done to create an interactive learning media on this unpleasant situation so that the author will do research with the title “Development of Interactive Virtual Laboratory Learning Media on Bacteria Staining Practicum for Universitas Negeri Medan Undergraduate Student.”

1.2 Problem Identification

Based on the background stated that has been described, the following are problems can be identified:

1. The obstacles in carry out practicum activities caused by the closure of laboratory in pandemic situation
2. The difficulties faced by college student in comprehend microbiology studies without offline practicum activities
3. The lack of laboratory equipments to carry out bacteria staining practicum at home
4. There is no virtual interactive learning media for bacteria staining practicum for Universitas Negeri Medan undergraduate students

1.3 Scope of Problem

Based on the identification of the problems stated above, scope of problem in this study is the development of virtual laboratory on Gram bacteria staining practicum for Universitas Negeri Medan undergraduate students as learning media to carry out practicum.

1.4 Research Question

Based on the background, problem identification and scope of problem stated before, the following are the research questioned:

1. What are the results of student needs analysis for the development of interactive virtual laboratory learning media on bacteria staining practicum for Universitas Negeri Medan undergraduate student?
2. How to design an interactive virtual laboratory learning media on bacteria staining practicum for Universitas Negeri Medan undergraduate student?
3. How is the feasibility of virtual laboratory learning media on bacteria staining practicum according to media expert and material expert?
4. How student response about virtual laboratory learning media on bacteria staining practicum for Universitas Negeri Medan undergraduate student?

1.5 Problem Limitation

Problem limitation are made to limit research scope so the research will done properly and directed. The limitation of the problem in this study is as follows:

1. This research is learning media development research in the form of virtual laboratory
2. The material on this research in staining of Bacteria, bacterial endospores and bacterial capsule staining
3. This research was conducted on 2019-academic year Biology and Biology education student on Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Medan
4. This research conducted using 4D model (Define, Design, Development, Disseminate) and limited to product trial stage.
5. Virtual Laboratory learning media are developed using Adobe Animate CC, Figma and Ibis Paint X
6. Evaluation on this research are formative evaluation focused on product validity by media experts, material experts and college students' perception using Likert Scale

1.6 Purpose of Research

Based on the description stated before, the purpose of this study is:

1. To know the result of undergraduate student needs analysis for the development of interactive virtual laboratory on bacteria staining practicum for Universitas Negeri Medan undergraduate student
2. To design the interactive virtual laboratory on bacteria staining practicum for Universitas Negeri Medan undergraduate student
3. To measure feasibility level of virtual laboratory media on bacteria staining practicum according to media expert and material expert
4. To observe students's response to the virtual laboratory media on bacteria staining practicum for Universitas Negeri Medan undergraduate students

1.7 Benefit of Research

1. Practical Benefit

a. For students

Developed learning media virtual laboratory on bacteria staining material able to help college students carry out practicum activities while on online learning on microbiology course using interactive learning media Virtual laboratory

b. For lecturers

Developed learning media virtual laboratory on bacteria staining material can be applied by teacher or lecturer to carry out lab activities to overcome obstacles that prevent practicum activities

c. For University

This study will add new innovation on education and ICT learning media development that can be implemented on teaching and learning process to improve learning quality

d. For other researcher

This study can be applied for other researchers as references with relevant research.

2. Theoretical Benefit

The result of this development research is to help students and teachers and other educators to carry out practicum activities using virtual laboratory

1.8 Operational Definition

Operational definitions are given to gain understanding and a clearer picture in interpreting the variables of the study in order to avoid differences in the interpretation of the terms contained in this study. The terms that need to be defined in this study are as follows:

1. Learning media is tools, methods, and techniques used to facilitate communication and interaction between lecturers and students in a more effective education and teaching process
2. Virtual laboratory (VL/Virtual lab) is a set of laboratory tools in the form of interactive multimedia-based computer software that operates with computer hardware can stimulate activity in the laboratory as if the user in in the actual laboratory
3. Interactive multimedia refers to digital products and services on computer-based systems that is equipped with a controller that can be operated by the user to present content such as text, motion pictures, animation, video, audio and simulation.

