

CHAPTER I

INTRODUCTION

1.1. Background

Education in the 21st century aims to build students' intellectual abilities in learning to be able to solve problems around them. Forming intelligence in the real world is not just knowing, but can solve problems faced in the environment in a meaningful, relevant and contextual way. Contextual learning of students, able to train critical thinking, mastering technology, cooperative, and collaborating is needed in solving problems. The goals to be achieved by students are very diverse, for example thinking skills, social skills, psychomotor skills, and process skills. The learning curriculum also aims to improve the quality of imagination and creativity; acquire human values, develop one's potential, develop critical thinking, and develop a committed and responsible personality (Zhou, 2005).

Learning that leads to independent learning so that students can construct their knowledge is still lacking. Independent learning has not been fully implemented and the management of skills in critical thinking has not been programmed intentionally. Students still depend on the teacher who acts as the main source of information, this causes boredom and does not empower students' critical thinking skills. The lack of total student involvement in learning is due to the lack of students trying to find information on their own, and this reduces the meaning of active and effective learning. Students tend to learn to be able to answer test questions by memorizing subject matter instead of understanding, analyzing a problem, and solving problems that may be faced on a daily basis, so that their critical thinking is less trained. As a result, in terms of cognitive is also lacking, as evidenced by the average acquisition of learning outcomes in previous competencies that are still less than the minimum competency standards, teachers often have to take remedial in every test that do.

Efforts to overcome these problems need to be carried out effective learning activities in shaping students to be able to learn independently without forgetting the cognitive, affective and psychomotor aspects, one of which is by using project-based learning. The project in question is to introduce students to learning media that has been developed previously and then interact about several

gas chromatography learning theories to students so that it can be determined the extent to which students' critical thinking skills are taught using the developed virtual laboratory media. The application of technology is very important, especially in the world of education today because of the increasingly advanced era and adequate facilities (Insyasiska ,2015).

The use of Information Technology has increased every year. This sparks innovation in the field of education to integrate today's developing technologies with education in order to improve the quality of education (Rahmani, et al 2017). Facilities in technology allows the delivery of material outside of the classroom and application and/or feedback is done when in the classroom (Esson, 2016), especially in chemistry. One example of technology in education is the use of software such as Moodle, Wiki, and Edmodo (Franklin and Smith, 2015) that supports mastery of 21st century skills (Kimianti & Prasetyo, 2019).

Chemistry as a branch of science is very closely related to practical activities in learning to provide a meaningful learning experience (Bortnik, et al 2017). Practical activities often begins with pre-practicum activities and ends with post-practice activities. Pre-practicum in the form of a test of students' understanding of the practicum that will be carried out and post-practicum in the form of evaluation and reflection. Without pre-practicum activities, student activity becomes low and practicum activities are just done. This is related to the findings the researcher's observation that in practical activities, the tendency of prerequisite (initial) knowledge low students have an impact on low learning outcomes, thus encouraging research to increase the initial knowledge of students. So, practical learning is important for developed with technology integration.

Efforts to develop practical learning that are currently being studied are the integration of the use of information technology in the form of a virtual laboratory (Dwiningsih, et al. 2018). This is based on the idea that information technology provides an alternative learning environment that can contribute to meaningful learning. In addition, previous research has been conducted reported that preparation for learning in practicum can be improved through the use of virtual laboratories as students become more confident and comfortable in doing practicums so that students' learning motivation increases. The use of virtual

laboratories has been proven to increase students' understanding, and can improve students' thinking skills (Widowati et al., 2017). Therefore, it is important to develop a virtual laboratory, especially in the field of chemistry.

Some of the benefits of using a virtual laboratory are that it allows students to receive reflections more quickly and correct misconceptions about the concepts being studied (Tuysuz, 2010). Practical activities in traditional laboratories that are expensive, complicated, and dangerous can be done safely and inexpensively in virtual laboratory activities. In addition, virtual laboratories can complement live learning where students can study independently and online, learn to use chemicals and instruments, and plan experiments according to practicum instructions. Furthermore, students' conceptual understanding will be better at the molecular level representation that cannot be observed and can improve students' critical thinking skills.

Critical thinking is often associated with analytical and reflective thinking, which basically means critical thinking is a thinking process with the aim of making rational decisions to decide a case or problem. Thinking is an activity that is looking for ideas by using various summaries that make sense. So what is the understanding of thinking is a process that runs continuously including the interaction of a series of thoughts and perceptions. Critical thinking is a process in which a person or individuals are required to interpret and evaluate information to make an assessment or decision based on ability, apply knowledge and experience. Critical thinking is a complex developmental process based on rational and careful thinking. Being a critical thinker is a common denominator for knowledge that exemplifies disciplined and independent thinking. Knowledge is acquired, studied and organized through thinking (Karakoç, 2016).

The learning experience is planned in writing, set forth in the form of a document, and carried out in the form of an educational process. The design is developed in such a way that it provides sufficient opportunities in time and variety of activities so that each student can develop his potential. One of the dimensions of student potential that the curriculum must develop is intellectual potential. This potential is often considered as the main potential in causing humans to be intelligent. Intelligence is the human quality of students which is

stated in the national education goals. Therefore, developing intellectual potential so that being an intelligent human cannot be ignored. An interdisciplinary approach is impossible if the students who live it are not smart. Especially if the learning is already at the high school level where the approach to thinking disciplines becomes a high concern, then the ability to think must be very high. High thinking ability at this level of education is the main requirement for a better life in society and the success of education in higher education (Situmorang,2020).

After we understand the ways and patterns of thinking and understand the importance of critical thinking skills in learning, then will enter the core of the background of this proposal which is about the importance of critical thinking in gas chromatography learning by using learning media. The subject of gas chromatography is one of the lessons that are often encountered in learning activities. Gas chromatography is one of the lessons that requires accuracy and critical thinking skills in studying it, this is because in gas chromatography learning, it will often find ways to read and analyze samples that will appear in graphic form. Learning activities that require critical thinking skills will be disrupted if the learning activities are not carried out properly, especially coupled with the pandemic which makes face-to-face learning to be replaced with online learning. This of course will greatly affect the ability of students to learn a subject, especially subjects that require students to be able to think critically (Situmorang, 2020).

Learning activities carried out online will have a fairly serious impact on students' abilities. This can be seen from student learning activities that should be carried out directly but instead have to be abolished because of the pandemic. One of the learning activities that can affect students' abilities is the absence of practicum activities in the laboratory, while gas chromatography learning is learning that requires practical activities directly into the laboratory to support success in the hope that students can understand learning optimally. The obstacles that exist in the case of learning that require critical thinking skills make the authors try to find solutions that can help overcome the problems that occur (Martalina 2018).

Innovation according to Schumpeter has the meaning, the effort to create and implement something into a combination so that, with innovation someone can add value to products, services, work processes, and educational policies not only for educational institutions but also stakeholders and society. Literally innovation / innovation comes from the word to innovate which has the meaning of making changes or introducing something new. Discovery has the meaning of finding something that actually existed before, for example the use of an inquiry learning model in Gas Chromatography subjects, to improve the quality of the learning. In the agency that was recently developed, the learning model has actually been implemented in the agency other countries, or learning models through the internet. Meanwhile, Invention has the meaning of a completely new invention that has not been created before.

The application of learning methods or approaches that are completely new in the area, but basically have been applied in other regions or countries with the aim of increasing the effectiveness and efficiency of learning. For example, along with technological advances, we can design learning via mobile phones or through games that did not exist before. So innovation can occur in all fields including education. Innovation can be done anywhere and anytime. Especially in the field of education, innovation usually arises from the anxiety and desire of certain parties regarding the implementation of education. For example, teachers' concerns about the teaching and learning process that are considered less successful, education administrators' concerns about teacher performance, or perhaps public concerns about performance and outcomes, even the education system. Anxiety - anxieties that ultimately form problems - problems that require immediate handling. Efforts to solve these problems then emerge new ideas or ideas as an innovation.

From the description above, learning innovation can be interpreted as a new effort in the learning process, using various methods, approaches, facilities and an atmosphere that supports the achievement of learning objectives. Hasbullah, 2001 argues that "new" in innovation is anything that has not been understood, accepted or implemented by the recipient of the innovation. It can also be said that learning innovation is an effort to renew the various components

needed in the delivery of subject matter in the form of knowledge from educators to students with the aim of improving the quality of ongoing education.

A virtual laboratory is one solution that will be offered to solve this problem. With the pandemic situation that requires students to study from home, practicum activities can still be carried out from home but online. This virtual laboratory will be presented in two-dimensional form, but students are expected to still be able to feel the actual practicum activities. Virtual labs are a great way for students to practice in a secure online environment. Through virtual science lab games and engineering simulation software, students can interact with elements, machines and interfaces. This virtual flash laboratory will be presented with interesting features that will make students who study it feel more comfortable and enjoyable but still for the main purpose, namely increasing students' critical thinking skills which will be seen from the results of analyzing in learning, especially in gas chromatography subjects.

This virtual laboratory is expected to stimulate students by allowing students to do practicum activities freely but bound in the sense that before students do practicum the students have been directed and guided by the teacher on how to use the virtual flash laboratory and the steps of the work carried out must be done by students. So, students remain under the supervision and guidance of teachers. This gas chromatography learning media has previously been found, but researchers in this case develop the media that has been found, in the form of modifications to the form which was initially in the form of a web, then modified into an application form, and added some animation features.

So to prevent the transmission of the covid virus, the virtual laboratory is indeed the best to replace the usual labs on campuses and schools because there is minimal physical interaction. Because with that, we avoid what is called a group, because if we study at school and in the lab there will be a lot of people and of course that is strictly prohibited during the current pandemic.

Virtual Laboratories or can be referred to as Virtual Labs are a series of laboratory tools in the form of interactive multimedia-based computer software, which are operated by computers and can simulate activities in the laboratory as if the user was in a real laboratory. Virtual Labs have the potential to provide

significantly improved and more effective learning experiences. The development of this virtual laboratory is expected to be able to solve learning problems experienced by students and overcome cost problems in procuring tools and materials used to carry out practical activities for underprivileged schools.

The virtual laboratory is very appropriate to be developed for chemistry practicum activities, including gas chromatography separation practicum which is one of the branches of analytical chemistry. Based on the characteristics of the chemical separation material, it is necessary to have skills in using practical tools and materials properly. Therefore, this study will develop virtual lab teaching materials with the aim of creating virtual laboratory teaching materials in an android and computer integrated chemical separation practicum, describing the validity and readability tests of virtual laboratory teaching materials in chemical separation practicum. The development of virtual lab teaching materials is expected to increase the achievement of competence in chemistry learning for affective, cognitive, and psychomotor knowledge, and can attract learning interest and critical thinking skills for students to explore the subject matter.

With the results of this study, the authors want to develop learning media in the form of webpage as learning media on gas chromatography material at State University of Medan. For this reason, the authors are interested in researching with the title **“The Development Of Virtual Laboratory To Improve Student Critical Thinking Skills On The Teaching Of Gas Chromatography”**.

1.2. Problem Identification

Based on the description of the problem above, it can be identified problem as follows :

1. Learning gas chromatography material has not trained students' critical thinking skills.
2. Teachers put a lot of pressure on students on aspects of knowledge and understanding in learning so that students are less trained to develop their reasoning power.
3. There are students who are passive and less able to develop the information obtained.

1.3. Research Scope

In order for this research to be more focused, the scope of the problem under study is limited to the following :

1. The critical thinking skills studied include the skills to consider whether sources are reliable or not, the skills to ask and answer questions, and the skills to observe and give conclusions.
2. The material used in the learning activities is limited to the concept of gas chromatography.
3. The method used in learning is the practicum method, and uses a sample of 1 class.

1.4. Problem Formulation

Based on these problems, the researchers formulated the formulation of the problem in this study, as follow :

1. What learning media that should be carried out to improve student critical thinking skills ?
2. What are the stages to eligibility criteria for teaching materials according to National Higher Education Standard (SNPT) ?
3. How is students' critical thinking skills when implementing the developed learning resources with Virtual Laboratory for the teaching of Gas Chromatography?
4. How is the student learning outcomes as the critical thinking skills consequences?
5. How is students' response after taught by using a learning resources with Virtual Laboratory in the teaching of Gas Chromatography topic?

1.5. Research Objectives

Based on the formulation of the problem above, the objectives of this study are:

1. To develop a virtual media as a virtual laboratory to improve student critical thinking skills on the teaching of gas chromatography.

2. To find out the results of the feasibility of learning media by two media and material expert lecturers using the National Higher Education Standard (SNPT).
3. To investigate students' Critical Thinking Skills after taught by using a learning resources with Virtual Laboratory in the teaching of Gas Chromatography topic.
4. To investigate student learning outcomes as the critical thinking skills consequences
5. To investigate students' responses through questionnaires when implementing the developed learning resources with Virtual Laboratory for the teaching of Gas Chromatography.

1.6. Research Benefit

From the results of this study, it is hoped that it can provide good benefits for all parties, especially those related to the world of education.

1. For teachers, the existence of this virtual laboratory media is expected to help teachers in teaching gas chromatography material.
2. For students, the existence of this virtual laboratory media can help students understand and know instrument of gas chromatography and can provide an overview in the form of text data, video, animation, audio.
3. For Institution, the existence of virtual laboratory media is expected to be a source of learning and information in studying chemistry in schools.\
4. For researchers, as a source of research material for researchers, especially in research on learning media, especially virtual laboratory development.

1.7. Operational Definition

Some of the operations in development research are:

1. Virtual Laboratory

Virtual Laboratories are a series of laboratory tools and create using Construct 2/3 in the form of interactive multimedia-based computer software, which are operated by computers and can simulate activities in the laboratory as if the user was in a real laboratory.

2. Media Feasibility

Media feasibility is the suitability of the media with the format, quality, and conformity of the concept so that it can be used as a learning media.

3. Critical Thinking Skill

Critical thinking consists of analyzing facts to fully understand a problem or issue. The critical thinking process generally includes steps such as gathering information and data, asking thoughtful questions, and analyzing possible solutions. Critical thinking is an activity rationale relating to delivery rational arguments.

4. Learning Activity

Learning activities are designed to develop learning that supports course outcomes. All learning activities should support course outcomes, and all course outcomes need to be supported by learning activities.

