CHAPTER I
INTRODUCTION

1.1. Research Background

Teaching Separation Analytical Chemistry holds significant importance in several aspects, something like foundation of Analytical Chemistry: Separation techniques form the backbone of analytical chemistry. They enable the isolation and purification of components from complex mixtures, which is crucial for subsequent analysis. Teaching separation analytical chemistry provides students with fundamental skills necessary for various fields within analytical chemistry. Understanding Complex Systems: Many natural and synthetic samples are complex mixtures containing multiple components. Separation techniques allow scientists to dissect these mixtures, enabling the identification and quantification of individual components. Teaching these techniques helps students comprehend the complexity of real-world samples and the necessity of separation for accurate analysis. Quality Control and Assurance: In industries such as pharmaceuticals, food and beverage, environmental monitoring, and forensics, ensuring product quality and safety is paramount. Separation techniques are essential for quality control and assurance processes, enabling the detection and quantification of impurities, contaminants, and active ingredients. Teaching separation analytical chemistry equips students with skills vital for maintaining product quality and safety standards. And also Instrumentation and Method Development: Separation techniques are often coupled with advanced instrumentation such as chromatographs and spectrometers. Teaching separation analytical chemistry involves training students in the operation and optimization of these instruments. Additionally, students learn to develop separation methods tailored to specific analytical challenges, fostering innovation and problem-solving skills with the interdisciplinary Applications: Separation analytical chemistry finds applications across various disciplines, including chemistry, biology, pharmacy, environmental science, and materials science. By teaching separation techniques, educators facilitate interdisciplinary learning, enabling students to apply their knowledge and skills to diverse scientific problems.

Research and Development Separation techniques play a crucial role in research and development activities, including drug discovery, environmental monitoring, materials characterization, and forensic analysis. Teaching separation analytical chemistry prepares students for careers in research and development by providing them with the necessary theoretical knowledge and practical skills with the environmental and Public Health because Separation techniques are essential for monitoring pollutants in air, water, and soil, as well as assessing their impact on environmental and public health. By teaching separation analytical chemistry, educators contribute to raising awareness of environmental issues and preparing future scientists to address these challenges through analytical approaches. Hands-On Experience Gas chromatography is a technique that involves the separation of volatile compounds in a gas phase. Understanding its principles, operation, and optimization requires hands-on experience with the instrument. Students need to interact directly with GC systems to grasp concepts such as injection, column separation, detection, and data analysis. Instrument Operation, operating a gas chromatograph involves several steps, including sample preparation, injection, column selection, temperature programming, and detector setup. By providing access to GC instrumentation, educators enable students to learn these operational procedures firsthand, fostering familiarity and confidence in handling analytical instruments with method Development: Gas chromatography methods are often customized to suit specific analytical requirements, such as separating target compounds from complex matrices or achieving optimal separation efficiency. Teaching GC instrumentation allows students to experiment with method development, including adjusting parameters like temperature, flow rate, and column dimensions to optimize separation performance and need the Data of Gas chromatography generates complex data outputs, typically in the form of chromatograms. Understanding and interpreting these chromatograms are integral parts of GC analysis. By allowing students to acquire real-time data from GC instruments, educators facilitate hands-on learning experiences in data interpretation, peak integration, quantification, and identification of analytes.

It will be difficult if there is no GC available for practicum. As an alternative, it is necessary to develop artificial learning media to facilitate active learning to improve

learning outcomes on the teaching of gas chromatography and the artificial learning media is a strategy to attract students' interest in studying chemistry.

From ancient times until now, the world of education has changed rapidly due to various scientific, technological, social and cultural processes. The curriculum is a guideline for classrooms, teachers and students to direct learning activities to achieve educational goals. The 2013 curriculum provides encouragement to teachers as facilitators who can provide opportunities for students to express themselves to advance (Kemendikbud, 2013). The rapid development of science has caused changes in all fields, including the field of education. One part of education that has changed is learning media. Previouslythe teacher gave material directly and personally to students on the blackboard,but now much of the material used is the learning environment (Purba, dkk 2020:1).

Based on problems that often occur in gas chromatography practicum, such as (1) damaged equipment, common problems are malfunctioning equipment such as gas chromatography columns, injectors, detectors, or pressure gauges. This can affect test results and cause difficulties in obtaining accurate data (2) Contamination sample contamination may occur during sampling or sample preparation. External contaminants such as dirt, lubricants or other unwanted substances can enter the system and affect the analysis results (3) Injection problems often arise when injecting samples into the column. The most common problems include a blocked syringe, an injectable volume that is not viscous, or loss of sample during injection. This can lead to inconsistent resultsand hard-to-reach data (4) Lack of resolution can be caused by various factors, e.g. B. selecting the wrong column, wrong carrier gas flow or wrong column temperature setting. This lack of resolution causes overlap between neighboringpeaks and reduces the accuracy of the analysis (5) Indicator variation the sensitivity or sensitivity of the detector of a gas chromatography system can vary. This can lead to differences in detector signal between experiments and make data comparison difficult (6) There is an error in the signal detector . Thismay be due to factors such as gas leaks, power outages or unstable environmental conditions (7) Interpretation of result of a gas chromatography analysis can be difficult. Peaks that are too broad, or peaks that are hidden can cause difficulties in identifying and measuring components.

As candidates for chemistry teachers, students of the Chemistry Education Study Program, FMIPA, Medan State University are also required to be able to conduct ICT-based research. This is in line with one of the flagship missions ofthe Chemistry Education Study Program, FMIPA, Medan State University, namely to develop the Chemistry Education Study Program to be ICT-based and characterized by the Industrial Revolution 4.0 platform, as well as future developments that are beneficial to the development of science and technologyand society. Along with the development of science and technology, educators must be more creative in developing the learning process, one of which is by developing learning materials. The need for teaching materials increases when the number and quality of existing teachers is insufficient. Educators should prepare, implement and evaluate learning using comprehensive textbook teaching. The availability of study materials is very important in the website ofknowledge to both students at schools and students at universities (Sary, Tarigan, & Situmorang, 2018). To solve this problem, it is important to have a good understanding of the basic principles of gas chromatography, maintain equipment properly, use proper analytical methods, and practice good validation and quality control in practice. If you encounter a problem that cannot be resolved, please contact yourteacher or designated subject matter expert for further assistance. In teaching and learning activities, teachers must be able to convey information and material in a way that is clear and easily understood by students. In addition, the information and material provided by the teacher influences the increase instudent learning. The low success of student learning is caused by the lack of alearning environment to facilitate learning which makes it difficult for studentsto understand subjects. Currently there are many problems in education that underlie or cause low student learning outcomes. Therefore, to overcome theseproblems, innovative learning media development is carried out using technology. Improving students' learning abilities, especially chemistry so that students experience meaningful, communicative learning and are able to optimally increase student learning motivation (Situmorang, 2018).

Student preparation is very important because education currently requires students to study independently or student-centered, seeking information from

various sources, including learning media independently. Therefore, innovationis carried out in chemistry learning to get good and effective chemistry learningmedia. In supporting teaching and learning activities, the media is a tool for communicating learning, expanding student inspiration for learning, and overcoming the limitations of space, time, and sensory power. Learning Mediais a container for conveying information and messages during learning. The purpose of learning media is so that students can easily understand the information and conveyed so the messages can optimally achieve their learning objectives. In the era of all-technology and information, the development of themedia has also progressed very rapidly. The use of technology and informationas a learning environment demands that learning be more interesting and not only teacher-centered. Mass media and information technology are indeed difficult to handle and require special expertise. However, it cannot be denied that technology and this knowledge-based learning environment cannot be avoided or rejected. This type of learning environment makes teaching and learning easier for the teacher, because the teacher can no longer explain the subject. And the reach of this technology-based media is very broad, making it easier for students to reach it. Technology and information-based media can bein the form of cellphones, laptops, the internet and so on (Zahwa, 2020).

Innovation is needed to realize the hope of increasing learning outcomes in the teaching and learning process. The solution to overcome this problem is the development of a learning environment, namely Android-based mobile learning (Santi et al, 2019). Ibrahim and Ishartiwi (2017) also saw the development of learning media, especially at the Android level as a new choice of interesting and fun learning. When students are interested in the media used, students feel more comfortable in learning (Utami et al, 2016).

Based on the above understanding, a good learning environment on Android must keep up with developments in education and technology that are increasingly developing. Silitonga dan Situmorang (2009), in the Effectivenessof Audiovisual Media on Student Achievement in Gas Chromatography Learning, states that the progress of learning chemistry is not as fast as the progress of science and technology, including the progress of chemistry. In fact,the rapid development of

science and technology is not in line with the development of education. Moreover, the process of learning chemistry is still considered difficult, in line with what Wisman said that chemistry is one of themost difficult subjects for most high school students. Learning Media is a learning environment that includes learning materials, computer systems based on learning objectives, learning orientation and development. With the increasing globalization of society, good teaching must also keep up with developments in technology, art and real life (Situmorang, 2014).

Chemistry learning is a branch of natural science (IPA) which seems difficult (Ramadhani et al, 2017). Chemistry is the science that studies the composition, structure, properties and changes of matter (Haase, 2022). While the concept of chemistry itself is a branch of physics that studies the composition, structure, properties and changes of matter (Wishart, 2023). This is the same as one of the chemical materials studied in separation chemistry courses at universities, namely gas chromatography. Separation chemistry is thestudy of the separation, identification, and quantification of chemical components in natural and man-made materials. Mastery of differential chemistry topics is very important to build understanding and mastery of basic concepts and analytical information needed by students.

Many factors reduce students' interest in learning differential chemistry, namely the subject is difficult to learn and students are unable to learn it (Yusfiani & Situmorang, 2011). This is possible because the teaching materials are not developed in accordance with the current curriculum with innovations, including material that is considered monotonous so that it makes students bored and less interested in the material so that students' skills decrease. One effort to solve this problem is to develop teaching materials in such a way that learning becomes more meaningful and optimally motivates students. The use of teaching materials must be increased according to the curriculum and technological developments (Arlitasari, 2013). To increase support, in additionto innovative teaching materials, it is necessary to use appropriate learning methods or models so that the learning of analytical chemistry material, especially gas chromatography material, takes place optimally. One model thatcan be applied is project-based learning (Tamin &

Grant, 2011).

As reported by Irwansyah et al. (2018), media such as Microsoft PowerPoint and other traditional media are often used by many people, but this technologyonly places 3 students as passive elements in the learning process. Therefore, the right educational materials to support student learning in a timely manner are interesting media (Astuti et al, 2018). Website-based multimedia development is very convenient and can be used anywhere and at any time (Harianto et al, 2017). Technology is used as an innovative learning tool that isconsidered timely (Ramud and Muchtar, 2018). Because technology is integrated into our daily life (Chuang, 2014). As technology develops, teacherscan use different resources depending on their learning needs and goals (Ramudand Muchtar, 2018).

As stated by Libman and Huang (2013), smartphones can act as an effective teaching tool that can enhance learning. In addition, learning feels more interesting, because textbooks are not only a source of learning (Adriani and Sabekti, 2018), but also contribute to the utilization of the learning environment in the implementation of learning, namely. reduce teaching time. At the very least, reducing the time the teacher writes on the blackboard and students take notes (Putra et al, 2020). Sari, (2019) also found that smartphones as a learning environment have several advantages. One of them is a smartphone, which is a mobile phone connected to the internet. In addition, smartphones allow studentsto study anywhere, anytime without time or location restrictions, smartphones are affordable mobile devices that can be purchased by the public and owned by almost everyone. The development of mobile learning by Sant et al (2019) has a very appropriate category, so it is very suitable for use in chemistry learning with a learning achievement level of 74 percent. The efforts to developan artificial media-based learning environment are also supported by Rusdi (2017) stating that research results show that the success rate in managing student learning is 83.33%. In terms of student actions and reactions as well asthe teacher's ability to manage learning, they are at a high level, meeting the performance criteria. The use of an android-based mobile learning environment on Gas Chromatography material affects performance related to student knowledge with an average of 80.88. Referring to

these problems, the background is the problem of teacher support in the provision of chemistry teaching materials and several studies with good validation results. Therefore, Referring to the above research accompanied by various opinions about the results of the study, the researchers are interested in conducting a study by it is very important for researchers to conduct research on the topic **"The Development of Artificial Learning Media to Fasilitate Active Learning toImprove Learning Outcome on The Teaching of Gas Chromatography"**

1.2. Problem Identification

Based on the research background above, there are several issues can be identified:

1. What are the stages to be carried out to develop an artificial learning media to improve student outcomes on the teaching of Gas Chromatography?
2. What are the contents to be integrated in the develop an artificial learning media of Gas Chromatography teaching to make the Analytical Chemistry teaching easily learn?
3. What is the strategy that will be carried out to standardize a developed artificial learning media in order to meet the eligibility criteria for teaching materials according to BSNP standards?
4. What are students' teaching and learning activities when implementing the development artificial learning media for the teaching of Gas Chromatography?
5. How good are the students' learning motivation after taught by using a development of the artificial learning media in the teaching of Gas Chromatography topic?
6. How effective is the developed an artificial learning media on mproving student learning outcomes in the teaching of Chromatography?

1.3. Problem Formulation

Based on the limitations of the problem above, the formulation of the problemin this study is:

1. What are the stages to be carried out to develop an artificial learning media

to improve student outcomes on the teaching of Gas Chromatography?

2. What are the contents to be integrated in the develop an artificial learning media of Gas Chromatography teaching to make the Analytical Chemistry teaching easily learn?
3. What is the strategy that will be carried out to standardize a developed artificial learning media in order to meet the eligibility criteria for teaching materials according to BSNP standards?
4. What are students' teaching and learning activities when implementing the development artificial learning media for the teaching of Gas Chromatography?
5. How good are the students' learning motivation after taught by using a development of the artificial learning media in the teaching of Gas Chromatography topic?
6. How effective is the developed an artificial learning media on improving student learning outcomes in the teaching of Chromatography?

1.4. Research Objectives

1. To develop an artificial learning media to improve student outcomes on the teaching of Gas Chromatography.
2. To identify the animations to be integrated in the develop an artificial learning media of Gas Chromatography teaching to make the Analytical Chemistry teaching easily learn.
3. To standardize a developed artificial learning media in order to meet the eligibility criteria for teaching materials according to BSNP standards.
4. To investigate students' teaching and learning activities when implementing the developed artificial learning media for the teaching of Gas Chromatography.
5. To investigate students' learning motivation when implementing developed artificial learning media in the teaching of Gas Chromatography topic.
6. To investigate the effectivity of a developed an artificial learning media on improving student learning outcomes in the teaching of Chromatography.

1.5. Research Benefits

This research is useful both theoretically and practically. The theoretical benefitof this research is as a source of scientific knowledge about android-based learning media in chemistry learning. While the practical benefits of thisresearch are:

1. Students can add information related to the development of learning materials on the website and gain experience in conducting research.
2. By adding gas chromatography material to chemistry learning material, teachers can use it as an independent learning tool to support the learning process and use media more effectively.
3. As an independent learning method that can be used anytime and anywhere.
4. Reference materials can be added to develop other products in line with the rapid development of the world of education and technology especially the development of an *Website-based* gas chromatography learning.