CHAPTER I
INTRODUCTION

1.1 Background

Virtual education, in general, refers to instruction in a learning environment in which teachers and students are separated by space, time, or both. Course information is delivered using IT applications, multimedia resources, the Internet, video conferencing, and other methods. The nature of the instructional relationship between teacher and learner, meaning the point in time at which the contact occurs, determines the three types of virtual courses. Asynchronous online courses do not take place in real time. Students are more self-sufficient, finishing their course work and assignments on time. Teachers and students communicate via discussion boards, blogs, and emails, among other channels. Class does not have a set time. Asynchronous learning is flexible and beneficial for students with time constraints or demanding schedules. In synchronous online courses, instructors and students must converse online at the same time. Students are taught via hybrid online courses and alternative blended courses that allow for both in-person and online interactions. Hybrid classes have in-person sessions one semester and computer-based communication the next. As a result, hybrid virtual learning can be both asynchronous and synchronous, and can include or exclude face-to-face interaction. In virtual classrooms, students can meet instructors and communicate with their teachers and classmates via text, audio, and video chat. Because of the synchronous learning environment, students can participate in classes from home in real time, allowing them to learn even through virtual teaching (Dung, 2020).

Virtual teaching via the calling app clearly diversifies delivery methods, hence improving faculty teaching experience. To become accustomed to this new method of teaching, teachers must typically attend multiple training sessions as well

as hours of self-taught practice. Furthermore, rapidly expanding information technology requires teachers to learn new tools and apps to augment the educational material and activities in their courses. According to research (Dung, 2020), 55% of students are from Ho Chi Minh City, with the remaining 45% coming from outside the province. However, the quality of Wi-Fi connections varies greatly, with 11% having a fast and reliable connection, 69% having an average connection, and 20% having a poor connection. It was also observed that 46% of students use cellphones and 45% use laptops for online study. Desktop computers (6%), as well as tablets (3%), are rarely used (Dung, 2020). And, it happens quickly after Covid-19 pandemic

Because of the Covid-19 epidemic, the alteration in learning habits appears to be substantial at all levels of education. Furthermore, the Industrial Revolution 4.0 is the state of the industry in the twenty-first century when enormous changes in numerous industries occur as a result of the integration of technology. Now, numerous businesses are beginning to enter the virtual world through human connectivity via machines, gadgets, sensors, and data, also known as the Internet of Things. In terms of the impact of the Industrial Revolution 4.0, specifically the 'digitalization of the system,' educators and students must be ready to quickly adjust to existing changes. The learning system that was originally based on face-to-face interaction directly in the classroom can be replaced with a learning system that is incorporated via the internet (online learning). Online learning is a type of distance learning that makes use of telecommunications and information technologies (Arizona et al., 2020).

Without the collaboration of proper learning methodologies and approaches, online learning will undoubtedly be less relevant. Project-based learning is one use that can incorporate online learning. The project-based learning method (PjBL) has been tested as an alternative to practical courses at the Universidad La Salle Mexico's Department of Chemical Sciences. PjBL has been shown to be beneficial in the development of soft skills like communication, teamwork, and issue and conflict resolution. Although this technique cannot replace actual experience, it is

proven to be a viable option for providing students with the necessary skills in a practical profession (Castaneda, et al., 2021).

The key component of project-based learning is composing and starting activities that highlight a number of projects until a final result is reached in the form of a product as a series of individual communication activities or diverse task outputs that answer questions. As a result, project-based learning allows students to master concepts in more detail while also improving their learning outcomes. Project-based learning is in-depth research of a real-world topic. A well-designed project challenges students to address real-world issues and problems that arise in everyday life, particularly during the learning process. Thus, student projects are based on observations of real-world situations in their surroundings that will create significance for them (Arizona et al., 2020). Projects in learning chemistry are usually carried out through a practicum.

Practicum in chemistry learning is a significant approach to improving chemistry understanding and application. Laboratory-based learning assists students in recalling theoretical information taught in lectures. The psychomotor dimension, on the other hand, is more significant because science learning involves not only a collection of knowledge, but also a human effort including the use of motor skills such as stringing and measuring equipment. These abilities are very useful in everyday life for students. The practicum's goal is to improve students' intellectual and psychomotor knowledge. According to Hofstein (2004), chemistry learning is less successful if it is not accompanied by practical exercises (Sumarni et al., 2016). Sumarni continued by stating that PjBL is a methodical teaching style that engages students in learning through research assignments, authentic questions, and well-designed products. PjBL fosters students' creativity and psychomotor abilities by directing them to create a product through learning activities (Sumarni et al., 2016).

Furthermore, Akinoglu (2008), Doppelt (2003), and Yalcin et al (2009) claim that PjBL improves student performance through product creation through

trials. Students can actively participate in learning activities in PjBL, and professors can observe their activities throughout the learning process. Students should be encouraged to generate things through projects assigned to them. Teaching aids can be utilized to provide fundamental experience in experimenting and explaining topics, and the teacher must also assist students in visualizing abstract concepts in order for them to be real and easily understood (quoted in Sumarni et al., 2016). The separation of substances by centrifugation is a notion that must be well visualized. Centrifugation separation is a method that uses centrifugal force to sediment a mixture by utilizing a centrifuge. The denser components of the mixture will flow away from the centrifuge axis and produce a precipitate (pellet), leaving the supernatant liquid to be extracted by decantation.

Based on the sentences above, it is necessary to apply effective learning to students to improve their competence. Especially due to the impact of the Covid-19 pandemic that hit so that learning did not run optimally because they had to stay at home and implement physical distancing. So that online learning with innovative project-based learning media is one solution to the problems faced to answer these problems. The learning media innovations that are made aim to increase students' curiosity about chemistry. In addition, when students learn about chemistry, they always focus on material concepts. Because the learning system used during the pandemic was lectures. So that way, students feel bored with lectures. In addition, they cannot apply the knowledge that has been obtained.

Therefore, it is necessary to create media that can access from phone **(appendix 1)** and from desktop **(appendix 2)** to make students want to learn chemistry even more. From the observations that have been made, it is also seen that students need to do practicum in order to help students understand the theory of centrifugation. Then based on observations that have been made to the sample, namely PSPK20B and PSPK20C, it was found that there are still many of them who still consider gadgets and cellphones as items that should not be forgotten when traveling to a place. But the problem is that they do not use this phone as a learning resource. The two classes will be used as control and experimental classes using

random sampling. The observations in the **Appendix 22.** Therefore, researchers will conduct research entitled "The Development of Virtual-Based Learning Media in Supporting Project-Based Learning to Improve Student Competence in Centrifuge Analysis".

1.2 Scopes of Research

Based on the background that has been stated, the researcher defines the problem so that the research is more focused:

1) The implementation is carried out on the chemistry material of the 5th semester students, class of 2020 with centrifugation material.
2) This learning media test includes testing the feasibility of the media not being tested on students, only used as a guide for conducting experiments.
3) This innovative learning media was created by the researcher herself and will be able to be used with android, and laptops.
4) This research is focused on implementing a project-based learning (PjBL) model with innovative virtual learning media to improve student learning outcomes on centrifuged materials.

1.3 Problem Formulations

Based on the above scope, the formulation of the problems obtained are:

1) How to develop innovative learning media based on 4D models in centrifuge analysis?
2) How is the feasibility of teaching materials made according to SNPT standards?
3) How is the difference between student learning outcomes in the control class and the experimental class?
4) How is the effectiveness of Virtual-Based Learning Media as Supporting Project-Based Learning in Improving Student Competence in teaching centrifugation?

1.4 Problem Limitations

Based on the problem formulation above, the problem limits obtained are:

1) This research was conducted on the KKNI student curriculum in 2022.
2) This research was conducted on the "Kurikulum Merdeka" in 2022.
3) Subjects are the 5th semester students, class of 2020 of Universitas Negeri Medan.
4) The material that is the focus is the centrifugation method of separation with materials that are often encountered in daily life.
5) The learning model is project-based learning.

1.5 Research Objectives

The objectives of this research are:

1) Through the use of project-based learning models with innovative learning media, educators can find out how to develop innovative learning media based on 4D models in centrifuge analysis.
2) Through the use of project-based learning models with innovative learning media, educators can determine the feasibility of teaching materials that have been made according to SNPT standards.
3) Through the use of project-based learning models with innovative learning media, it can be seen that different higher learning outcomes between the two sample classes.
4) Through the use of project-based learning models with innovative learning media, it will be known how the effectiveness of Virtual-Based Learning Media as Supporting Project-Based Learning in Improving Student Competence in teaching centrifugation.

1.6 Research Benefits

The research benefits will include theoretical and practical benefits. Theoretically, it can be employed as a new learning medium, particularly for

centrifugation content. While in terms of practical benefits, you will receive: It can help researchers increase their knowledge and training skills as future educators and in creating creative learning media. It can be utilized as an alternate learning resource for teachers, particularly when learning online. It can also be utilized as a learning resource for students during online learning, particularly for centrifugation content.

1.7 Operational Definitions

Some things that need to be emphasized by researchers in this study are:

a. Virtual learning media is a communication relationship that will function smoothly and efficiently when a tool called communication media is used. The virtual learning media can improve students' competence in centrifuge analysis, which is intended to improve learning results.
b. Innovative learning media focuses on students' learning competence in centrifuge analysis that are designed, produced, and managed creatively and dynamically, by adopting a multidirectional strategy to improve, and by utilizing the most recent media to create a favorable atmosphere and learning process for students in centrifuge analysis.
c. An "e-Learning" teaching and learning approach in centrifuge analysis creates knowledge in real time as science is created through the use of information technology, in this case the internet. Hybrid learning will be applied in the project of centrifuge analysis. Traditional training methods, such as classroom instruction, are combined with online learning resources in hybrid learning activities.

d. Improving learning outcomes for centrifuge analysis is the process of modifying a subject's behavior, including cognitive ability in certain settings, as a result of repeated encounters.