CHAPTER I
INTRODUCTION

1.1 Background

Science learning is a lesson that can improve students' knowledge, competence, and self-confidence so that they understand and observe the surrounding environment objectively. Science learning in the 21st century, or the technological century, requires teachers to have teaching skills by utilizing technology. However, not all schools have access to adequate facilities to support science learning. In addition, some students may find it difficult to conduct direct experiments due to limited resources. There are several obstacles experienced by teachers and students when carrying out practicums, such as time constraints, inadequate laboratories, and security factors. To overcome these problems, teachers must be creative in realizing learning, namely using virtual laboratory-based learning as a more effective and efficient learning medium. Students can become more actively engaged in learning through practical activities using virtual labs, which can improve their critical thinking skills (Bogar et al., 2023).

The development of critical thinking skills among students in Indonesia is even less encouraged. In the process of learning, students have a tendency to memorize only the material presented by the teacher. According to Patmah et al. (2017) teacher-centered learning means that students never prepare before learning begins. This results in low interest in learning among students. This is emphasized by Herliandry et al. (2018), who stated that low interest in learning arises from learning that is less interesting, so that it can cause students to be reluctant to learn. This is consistent with Snyder & Snyder (2008) research that the rote learning process does not improve students' critical thinking skills. According to Latifa et al. (2017), critical thinking skills are those that are involved in making decisions. According to Nasir et al. (2015), there is a need for teachers to plan and implement learning that can develop the critical thinking skills of students. Therefore, for meaningful learning to take place, teachers need to be able to train students to think critically in analyzing and solving existing problems in order to make decisions (Khasani et al., 2019).

Based on the results of observations and interviews at UPT SMP Negeri 27 Medan with science teachers and students taught in grade VIII. According to interview findings, teachers often use differentiated learning according to the implementation of the independent learning curriculum. Differentiated learning applied by teachers is a conventional model or direct teaching with discussion, lecture, question and answer, demonstration methods. Practical activities are rarely carried out because laboratory equipment is damaged and inadequate, so teachers only demonstrate practicums. Students are instructed to bring additional tools such as pendulums for each group. In the learning process, teachers seldom engage students in experimental activities and direct observations.

This is due to the lack of skill of equipment in the laboratory. And there are also some science materials that cannot be practiced directly. As a result, students are less enthusiastic about participating in science learning, students' lack of motivation to learn independently, and students' critical thinking skills are less facilitated. So that students feel bored and tired while carrying out learning, this can be observed from several students who are sleepy during learning. Teachers as sources of information make students focus only on listening to the teacher, and students are used to taking notes after the teacher explains.

The teacher explained that the thinking skills of the students were still at a low level. This is because many students initial cognitive assessment scores have not met the KKM. The Minimum Completion Criteria (KKM) is 75. The average value of vibration and wave learning outcomes is still relatively low, where 60% of students have not completed the KKM. This shows that the learning process that has been carried out has not reached the target, as a result, students' critical thinking skills have not been achieved.

Difficulty in understanding concepts is related to low levels of critical thinking. Inadequate understanding will lead to low critical thinking skills in students. An effective way to overcome this problem is to use student-centered learning with interactive, animated, and game-like learning. Implementing student-oriented learning (student centered) so that students can be creative directly. Student-oriented learning includes discovery and inquiry learning and inductive learning strategies (Sihombing & Ginting, 2023).

The guided inquiry learning model serves as a model designed to enhance students' critical thinking skills, particularly within the context of science education. This model of learning requires the student to be an active participant in the learning process, allowing them to engage more deeply with the material, while encouraging students to optimize their skills and abilities. The guided inquiry learning model is a model that actively engages all students in utilizing their abilities to explore, examine, and analyze a given problem in a critical, logical, and systematic manner. This process encourages them to seek out and discover answers independently while being supported by the teacher's guidance, fostering confidence in their problem-solving skills (Yeritia et al., 2017).

The guided inquiry learning model consists of several essential steps, including presenting a problem to be explored, formulating or proposing hypotheses related to the problem, carrying out experiments to gather relevant information or data, systematically collecting and thoroughly analyzing the obtained data, and finally, drawing well-founded conclusions based on the analysis (Musyawir et al., 2022).

In this particular learning model, the teacher does not play a dominant role, instead students are encouraged to actively participate in their own learning process. The teacher's primary responsibility is to serve as both an organizer and a facilitator, ensuring that the learning environment supports student engagement. Rather than directly explaining concepts to the students, the teacher provides guidance that allows them to explore and discover these concepts through various structured learning activities. This model helps students retain the knowledge they acquire from their learning experiences over an extended period. Furthermore, the stages of the guided inquiry learning model are designed to support activities that foster the development of students' critical thinking skills (Nurmayani et al., 2018). This model encourages active exploration of concepts and meaningful problem solving. Guided inquiry learning and the free virtual lab site (PhET) are believed to meet the criteria. The guided inquiry model utilizing PhET in learning about vibrations and waves can help students develop their critical thinking skills (Yulianti et al., 2021).

In fact, what makes students better understand the material they are studying is by inviting students to participate in real-based learning. Teachers never use PhET simulation media and only carry out practical activities in the laboratory. To overcome this, teacher creativity is needed in creating learning that is not much different from experiments carried out in real laboratories, namely by using Virtual Laboratory, one of which is PhET Simulations. Through the use of Virtual Laboratory, it is hoped that students will understand the concepts taught, so that learning can take place effectively and efficiently. The application of the guided inquiry model can improve students critical thinking skills with the highest indicator, namely the indicator of designing experiments. Students gave a positive response to the implementation of the guided inquiry model in learning, as it helped them explore science concepts on their own (Djola et al., 2021).

Vibration and wave material is generally difficult to learn because its application is abstract. The topic of vibration and wave science is one of the subjects used to enhance critical thinking skills. Students have difficulty digesting the material and applying formulas to questions given by the teacher. In addition, vibration and wave material also requires students to carry out laboratory activities by applying critical thinking skills. In this case, it is recommended to design an auxiliary media that is useful for explaining concepts contextually from an abstract concept. One type of learning media that can be utilized is PhET simulations (Subeki et al., 2022). PhET Simulation is very necessary during the learning process because the abstract nature of vibration and wave material causes students to have difficulties, for example if students have to determine the amplitude and frequency. In conventional learning such as using ropes, students cannot set variables such as amplitude and frequency. It is different when using PhET Simulation, students can conduct experiments that can make it easier for students to manipulate variables such as amplitude and frequency (Mahardika et al., 2022).

The technology used in the virtual laboratory is PhET (Physics Education Technology) which can help students master the theory of science lesson experiments with simulations. PhET (Physics Education Technology) is free software from the University of Colorado. Simulations in PhET are interactive,

packaged in a game-like form so that students can explore. Through PhET simulation, it will attract students attention and students will concentrate on paying attention. In addition, PhET Simulation is a means that can provide visual experiences to students, making learning more engaging, in order to encourage critical thinking training for students, simplifying complex and abstract concepts to be simpler. PhET simulations also allow students to experiment freely, making learning more engaging and interactive. The use of these simulations helps bridge the gap between theoretical knowledge and practical application, making abstract concepts easier to understand, thereby enhancing students understanding. Consequently, students become more eager to learn and engage actively in science lessons. As a result, students' critical thinking skills are expected to improve (Bogar et al., 2023).

Critical thinking seems to be an interesting topic that is much discussed in the educational world today. In the 21st century, students are required to develop skills in solving problems with both critical and creative thinking. This skill is essential for navigating complex challenges in both academic and real-world settings. They need to have the ability to critically solve problems by using analytical skills that take into account various aspects based on logical and innovative reasoning. Critical and creative thinking are essential skills needed in the 21st century (Bialik & Fadel (2015); Scott (2015); Griffin & Care (2014)). Ennis (2011) describes critical thinking as "reasoned reflective thinking focused on deciding what to believe or do." This means that critical thinking involves using logical reasoning and careful reflection before making a decision on a particular issue. In other words, it involves analyzing information carefully to make well-founded judgments. Critical thinking skills encompass cognitive levels C4 (analyzing), C5 (evaluating), and C6 (creating) according to Anderson's revision of Bloom's Taxonomy. These levels require deeper reasoning and problem-solving abilities. This critical thinking ability is related to the concept of Higher Order Thinking Skills (HOTS). Meanwhile, cognitive levels C1 (remembering), C2 (understanding), and C3 (applying) are still categorized as Lower Order Thinking Skills (LOTS) or basic-level thinking skills (Jiwandono, 2019).

According to the research conducted by Agustina et al. (2020), the posttest results on students' critical thinking skills in both classes indicated that the experimental class achieved higher scores than the control class. The final test of critical thinking skills uses 4 indicators, namely basic classification, basic decisions, inference, further explanation. Critical thinking indicator 1 in the control class 75% and in the experimental class 84%. Critical thinking indicator 2 in the control class 53% and in the experimental class 60%. Critical thinking indicator 3 in the control class 29% and in the experimental class 32%. Critical thinking indicator 4 in the control class was 85% and in the experimental class was 90%.

Based on research by Subeki et al. (2022) entitled PhET simulation media based on guided inquiry on vibration and wave material on improving students science process skills shows that based on the pretest and posttest N-gain test value of 0.70, so it is categorized as high. In the science process skills of each aspect, there are four aspects with high categories, namely formulating problems, identifying a variable, interpreting data and drawing conclusions. While the aspect of formulating hypotheses has a medium category. Based on the data on students' responses to the use of PhET based on guided inquiry on vibration and wave material, it shows high interest with an overall average of 88.6%.

Researchers will implement the guided inquiry learning model based on PhET media, with a slight modification compared to previous research, particularly in terms of students' critical thinking skills. This model encourages students to take a more active role in learning and explore concepts in greater depth. The use of PhET media helps students visualize abstract concepts more clearly, enhancing their understanding. It is expected that this model will lead to an improvement in students' critical thinking skills compared to their previous level.

From the description above, the researcher is interested in conducting a study with the title of "The Effect of Guided Inquiry Learning Model Based on PhET Media on Critical Thinking Skills of Junior High School Students in Vibration and Wave Material".

1.2 Problem Identification

Based on the description of the background of the problem, several problems can be identified as follows:

1. Teachers still use conventional learning models where learning is still very ordinary, there is no learning innovation, especially the use of guided inquiry models.
2. Students feel bored and saturated during learning.
3. Rarely do practical work because there are obstacles in the practical equipment being inadequate.
4. Teachers rarely measure students critical thinking skills in learning.
5. Teachers rarely use learning media.
6. Critical thinking skills of student are still low level.

1.3 Scope of the Problem

Based on the identification of the problems that have been described, the scope of the problem in this study is as follows:

1. This research focuses on the effect of the guided inquiry learning model based on PhET media.
2. This research focuses on the material of vibrations and waves at the junior high school level.
3. The skill studied in this research is critical thinking skill.
4. The subjects of this research were grade VIII junior high school students at UPT SMP Negeri 27 Medan.

1.4 Problem Definition

Based on the extent of the problems found, the problem limitations are determined so that this research is more focused. The problem limitations in this study are:

1. The learning model used is a guided inquiry learning model based on PhET media.
2. The applied material is limited, only vibrations and waves.
3. The skill testing in this research is the critical thinking skill of students.

4. The target of the research was class VIII students of UPT SMP Negeri 27 Medan.

1.5 Problem Formulation

Based on the identification of the problem, the problem in this study can be formulated as follows:

1. Is there any effect of the guided inquiry learning model based on PhET media on the critical thinking of class VIII students at UPT SMP Negeri 27 Medan on the material of vibrations and waves?
2. What are the critical thinking skills of class VIII students at UPT SMP Negeri 27 Medan who are improved using the guided inquiry learning model based on PhET media?

1.6 Research Objectives

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

1. To determine the effect of the guided inquiry learning model based on PhET media on the critical thinking of class VIII students of UPT SMP Negeri 27 Medan on the material of vibrations and waves.
2. To determine the critical thinking skills of class VIII students of UPT SMP Negeri 27 Medan who are improved using the guided inquiry learning model based on PhET media.

1.7 Benefits of Research

The expected research benefits in this study are:

1. Theoretical Benefits

   Theoretically, this study will help because it will provide details of the guided inquiry learning model based on PhET media, which can be used as reading, comparison, and source of information when researching related issues.

2. Practical Benefits
   a. In junior high schools where the research took place, it can be used to inform the creation and development of science teaching.

b. Information about the guided inquiry learning model for subject teachers as an effort to improve critical thinking skills.
c. For students, this will improve their critical thinking skills and encourage them to be more independent and active when they learn.