CHAPTER 1
INTRODUCTION

1.1. Background

Education is an important aspect, especially in improving the quality of human resources. Through education, humans can have better value and dignity. Through education, humans can not only be literate in science but also can use technology to advance the nation. To form a developed country, it is necessary to have good quality human resources to process existing resources. To process resources, science and technology are needed. With science and technology, it is hoped that humans will be able to face challenges in the future. Humans must be able to continue to innovate to meet global competition.

Science learning is learning that studies natural phenomena, objects in nature and their interactions that are oriented to the applicative, developing thinking skills, learning abilities, curiosity and developing caring and responsible attitudes towards the natural and social environment. Based on the 2013 curriculum development guidelines, science learning at the junior high school level is carried out on an integrated basis. Science learning in junior high schools is developed through integrated science subjects, which combine various aspects such as attitudes, knowledge, and skills. To develop students' understanding of natural phenomena and science concepts in everyday life, it is important to learn science at the junior high school level.

The government's efforts to improve the quality of education in Indonesia are still not optimal. Based on PISA (Program for International Student Assessment) in 2015, Indonesia was still ranked 64th out of 72 countries. Indonesia received a score of 386 with an average score of 490 in mathematics and obtained a score of 397 out of an average score of 493 in the field of reading and in the field of science, Indonesia received a score of 403 from an average score of 493. According to Tohir (2019), Indonesia in 2018 decreased compared to 2015. Indonesia was ranked 7th from the bottom out of 79 countries.

Based on the results of observation conducted with eighth-grade science teachers at SMP Negeri 14 Medan it was found that in the daily test on work and simple planes in daily life, student learning outcomes have not reached the minimum criteria (KKM) specified, namely 80. The results of daily test test for 1st semester in 2021/2022 grade VIII students at SMP N 14 Medan in the science subject matter of work and simple planes in daily life can be seen in the following Table 1.1 below:

Table 1.1 Student Learning Outcome

Class	KKM	Average value	Information
VIII-1	80	69.2	Not Complete
VIII-2	80	73	Not Complete
VIII-3	80	54.85	Not Complete
VIII-4	80	69.8	Not Complete
VIII-5	80	58.75	Not Complete
VIII-6	80	60.8	Not Complete
VIII-7	80	77.6	Not Complete

Science learning is not only about understanding concepts or cognition. In science subjects, students must also have affective and psychomotor abilities. Based on the results of interviews conducted with eighth-grade science teachers at SMP N 14 Medan, from problem-solving measurement indicators, students are only able to recognize the problem and represent the problem in the daily activity of learning from the five aspects of problem-solving, namely: (a) recognize the problem, (b) represent the problem in formal terms, (c) plant a solution, (d) execute the plan, (e) evaluate the solution (Walker *et al*., 2016).

Interesting learning is learning that has a lively atmosphere, where the interaction between the teacher and students goes well. The teacher does not only explain the material, and students only accept the material presented by the teacher. However, active learning interactions between teachers and students run in balance. While teachers and students exchange opinions and ask each other questions, there are still many students who are not active in participating in learning. Students are still passive in participating in education, where students

still do not pay attention to the teacher's teaching and are reluctant to ask questions, in group discussions, there are still many students who only rely on their themes, and students also do not play an active role in conversation in group discussions, there is still a lack of problem-solving, students also have difficulty in presenting or communicating the results of their arguments, students also have difficulty responding to questions, and have difficulty accepting other people's opinions (Sucipto, 2020).

In teaching and learning activities, the teacher has tried to turn on learning so that students are more active in the teaching and learning process, but students still do not have the expected learning activities. Many students tend to be passive in learning, and students still need to be ordered to express their opinions or ask questions. Students also experience difficulty in solving problems encountered in real life.

A learning model that can improve students' problem-solving abilities and a learning model that can improve student learning activities is needed. From the description of the problems obtained from initial observations and interviews with science teachers at SMP Negeri 14 Medan, a learning model is needed that can improve student learning outcomes, not only in terms of cognitive but also in terms of affective and psychomotor. This learning model must be able to cover all of the above problems.

Science learning in the 2013 curriculum provides a reference for choosing a learning model following the learning material. The choice of learning model is given to the teacher according to the characteristics of the learning material. Several learning models suggested in the 2013 curriculum include Project Based Learning (PjBL), Problem Based Learning (PBL), or Discovery Learning. The Project-Based Learning (PjBL) learning model is one of the learning models specified in the 2013 curriculum. This learning model is student-centred and provides experience from the concept, manufacturing process, and final result in the form of a project. This Project-Based Learning (PjBL) learning model not only improves learning outcomes but can also increase student learning activities

through the project-making process and improve the final product's problem-solving abilities (Afriana *et al*., 2016).

The Science, Technology, Engineering, and Mathematical (STEM) learning approach is here to meet the demands of the 21st century, aiming to improve problem-solving in various disciplines. STEM is the result of technology development to face global competition. The purpose of the STEM approach is so that each individual can face global competition, can be problems solving for every situation and increase interest in various disciplines (Gulen, 2018). Based on Nguyen, (2020) states that STEM learning has many benefits, including fostering interest in the teaching and learning process so that students can be more active in participating in the teaching and learning process. The benefits of the STEM learning approach can also apply to interdisciplinary knowledge to solve real-life problems. By using the STEM approach, students can also work together actively and individually so that students are accustomed to carrying out scientific activities. From the explanation of the benefits of STEM learning, it can be seen that STEM learning is an approach that is needed to improve the quality of human resources in the industrial revolution 4.0.

Project-based learning (PjBL) model integrated STEM is an integrated project learning model by science, technology, engineering, and mathematics (STEM) based on constructivist teaching theory, combining interdisciplinary knowledge of science, technology, engineering, and mathematics through project-based learning strategies. The PjBL integrated STEM learning model allows students to explore authentic experiences and real-life design solutions to develop problem solving skills. In the PjBL integrated STEM learning model, students must solve real-life problems through science, technology, engineering, and math-based projects (Sukmawijaya *et al.*, 2019).

The PjBL integrated STEM learning model is very effectively applied, based on research by Tseng *et al* (2013), revealing that PjBL integrated STEM can increase student interest in learning, and learning becomes more active and exciting. It can improve students' ability to solve real-life problems and support

future careers. The PjBL integrated STEM learning model can train students' thinking skills. This can be proven because it can increase students' curiosity and trigger creative and critical thinking. The PjBL integrated STEM learning model not only discusses concepts, but students are brought to carry out activities in the project-making process so that students are more active in teaching and learning activities. This can improve higher-order thinking skills (Sukmawijaya *et al.*, 2019).

Improving students' problem solving abilities using the PjBL integrated STEM learning model can be seen in research Parno *et al.*, (2020) with the title The effect of project-based learning integrated STEM on problem solving skills for students on the topic of electromagnetic induction. In addition to research, Sarwi *et al.*, (2021) with the title Implementation of Project Based Learning on STEM approach to improve students' problem solving abilities where the experimental class has an increase in problem solving skills of 66% to 81%. It was found that students who learned to use the STEM integrated PjBL learning model had higher problem-solving abilities than conventional classes based on N-gain results. Analysis showed that the Experiment class had a higher score than the Comparison class (0.502 compared to 0.315, respectively).

Based on the problem description, the research with the title "The Influence of the Project Based Learning (PjBL) Integrated STEM on Students' Problem Solving Abilities on Substance and Pressure Materials and Its Application in Daily Life" has been done.

1.2. Identification of Problems

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

a. Based on PISA (Program for International Student Assessment) in 2015, Indonesia was still ranked 64th out of 72 countries in Science (Tohir, 2019)

b. Students have learning outcomes that do not meet the minimum completeness criteria (KKM).
c. There is still a lack of problem-solving students in solving science problems in everyday life.
d. Students are passive in teaching and learning activities.
e. Lack of application of learning models enables students to grow good problem solving with scientific steps in daily life.

1.3. Scope of The Problem

a. Natural Sciences (IPA) subject matter of substance pressure and its application in daily life.

   Basic competence 3.8: explaining the pressure of substances and their application in daily life, including blood pressure, osmosis, and capillarity of transport tissues in plants.

   Core competence 4.9: presenting data and experimental results to investigate the pressure of a liquid at a certain depth, buoyancy, and capillarity, for example, in plant stems.
b. Implementing learning using a project-based learning model (PjBL) integrated STEM.
c. The research subjects were eight-grade students of SMP Negeri 14 Medan.
d. Problem-solving measurement indicators. In this study, problem-solving measurement indicators consist of 5 aspects, namely: (understanding the problem, (b) describing the problem, (c) planning a solution, (d) implementing the solution, (e) evaluating the solution (Walker *et al.*, 2016).

1.4. Formulation of the Problem

Based on the background and identification of the problems described above, the researchers formulated the problem as follows:

a. How is the influence of the PjBL learning model integrated STEM on students' problem solving abilities in the matter of substance pressure and its application in everyday life at SMP Negeri 14 Medan?

1.5. Limitation of Problem

So that this research is more focused, the researchers limit the research problems as follows:

a. Learning activities using the PjBL model integrated STEM begin with reflection, research, discovery, application and communication.
b. Problem-solving measurement indicators. In this study, problem-solving measurement indicators consist of 5 aspects, namely: (a) understanding the problem, (b) describing the problem, (c) planning a solution, (d) implementing the solution, and (e) evaluating the solution. (Walker *et al.*, 2016).
c. This research is only limited to the concept of substance pressure and its application in daily life.

1.6. Research Purposes

From the above problems, the objectives of this research are:

a. To find out how the influence of the project-based learning (PjBL) model integrated STEM on students' problem solving abilities on the material substance pressure and its application in daily life at SMP Negeri 14 Medan in class VIII.

1.7. Benefits of Research

The benefits of this research are:

1.7.1. Theoretical

The results of this study are expected to provide an increased understanding of the science learning model in teaching and learning activities. This research will also likely influence student problem solving in science subjects by using the project-based learning (PjBL) model integrated with STEM.

1.7.2. Practical

Practically, this quasi-experimental research will eventually be able to provide benefits for several parties, namely:

1.7.2.1 For teachers

As input for teachers as a reference for the application of learning models that can affect student problem-solving.

1.7.2.2 For student

This research is expected to improve students' problem solving abilities.

1.7.2.3 For researchers

It is hoped that this research can be one of the experiences and knowledge about applying learning models that can improve student problem solving as prospective teachers.

1.8. Operational Definition

Some of the terms in this study include STEM (Science, Technology, Engineering and Mathematics), PjBL (Project Based Learning), and Problem Solving. The description of these terms is as follows:

1.8.1 PjBL

Project-Based Learning (PjBL) is a learning model that produces a final product in the form of a project that is useful for solving various real-life problems. The characteristics of the Project-Based Learning (PjBL) learning model are that it can develop students' thinking skills and creativity and encourage them to work together and collect information independently (Chiang & Lee, 2016).

1.8.2 STEM

STEM (Science, Technology, engineering and mathematics) was a learning approach introduced by the National Science Foundation (NSF) in the United States in 1990. The term STEM is used to improve abilities that are not only in concepts or science but also must be able to be literate in technology, engineering and mathematics. This approach is expected to increase global competitiveness.

STEM (Science, Technology, engineering and Mathematics) consists of four components, namely: (1) Science, to develop interests and skills about the world of life, material and physical, as well as develop collaboration skills, research, scientific investigations and experiments, (2) Technology, covers various fields that involve the application of knowledge, skills, and computational thinking to meet human needs easily and quickly, (3) engineering, is the ability to think critically and design in every problem in everyday life, and (4) mathematics, namely the skills needed to analyze various information, simplify problems and solve problems or problem-solving (Meita *et al*., 2018).

1.8.3 Problem Solving

Problem-solving or problem-solving ability is a logical thinking process to determine the most efficient way to solve a problem. Problem-solving or problem solving can also be interpreted as intellectual activities or scientific activities in solving a problem using scientific steps so that students need to have evidence or publications of solving these problems (Lubis *et al*., 2019).