CHAPTER I
INTRODUCTION

1.1 Background

Globalization has a significant increase in the world population. There will be 8 billion population in 2025 and over 9 billion population during the next twenty years, 2045 (Department of Economic and Social Affairs United Nation, 2019). The growing number of human populations has a direct impact on environmental damage (Weber & Sciubba, 2019). The statement is supported by the increasing amount of Indonesian population obtained by the census result (BPS, 2019). The data shows, there were 238.518,8 population in 2010, whereas the data leads to an increase in 2018, with 264.161,6 population. This also presents the data on environmental pollution in Indonesia based on the 2014 and 2018 Village Potential Statistics of Indonesia. The data are shown in 2014, water pollution 10.63%, land pollution 1.58%, and air pollution 14.60%. Whereas in 2018, the percentage of water and soil pollution has increased, currently the percentage of water pollution to 25.11% and soil pollution 2.69%. But for air pollution, the percentage is reduced to 11.83%.

The issues between population growth and environmental change arise from various factors (Weber & Sciubba, 2019). The factors including natural resources like a volcanic eruption, flood, and many more (Appannagari, 2017). The same paper mentioned, it is damaged by human-made such as waste. Waste has the potential to suppress environmental conditions, including soil, water, air, and the whole ecosystem. Indonesia's major city areas produce almost 10 million tons of waste each year, which increases by between 2 until 4 percent (BPS, 2019). How waste is treated and stored also contributes to environmental (Abdel-Shafy & Mansour, 2018). However, waste management in Indonesia is deemed insufficient (Mahyudin, 2017). Since waste management is crucial in a country, thus the cooperation between the government and citizens is needed to seek the solution of it. The lack of attention to the problem-solving solution of environmental pollution and inadequate technology for the proses also become a problem to the environmental quality (Kumar & Pande, 2017).

In line with today's world challenge to face the current situation of environmental pollution, it also needed skill and strategy to overcome the problems. Based on PISA's report, Indonesian is ranked 70th out of 78 listed countries in science subject with score 396, meaning it is included in the level 1a (OECD, 2018). The results showed that several Indonesian students who joined PISA, only 7% from them could be categorized into levels 5 and 6. Generally, students' ability to solve science problems is still weak.

Previously there are already several similar pieces of research that have investigated on the problem-solving skill. The research shows the application of the STEM approach to improving problem-solving skills due to the ability of students is quite low, especially in learning physics (Dewi, Kaniawati, & Suwarma, 2018). Another result was conducted in Malang, there is no increase in the ability to solve problems even though the fact is relatively low, the n-gain obtained only 0,3 (Batlolona, Baskar, Kurnaz, & Leasa, 2018). There is also a study that divided students into 2 groups in biology class. However, none of them had a higher value on problem-solving skills. The result shows, group A was 37.81% and group B was 32.26% which categorize into a low category (Rindah, Dwiastuti, & Rinanto, 2019). The last, one MTs in Ponorogo District, 50.12% of students fall into the low category of problem-solving skills (Alfika & Mayasari, 2018).

Based on the above facts, students in Indonesia generally still have low problem-solving skills. It was a warning to all those involved in education, especially in this study. Currently, problem-solving skills becoming primary goals in basic education (OECD, 2018). Thus, the selection of this variable intends to train students from an early age. Problem-solving abilities possessed by students must be improved as a basic skill required for everyday learning to prepare students' futures (Yu, Fan, & Lin, 2015).

However, to carry out activities in problem skill development, a strong belief within each student is needed. Someone's belief in the ability to manage and execute actions to deal with a potential situation is called self-efficacy (Bandura, 1995). Nevertheless, several studies that previously conducted self-efficacy research show unsatisfactory data. The score from 31 students are below the average when taking a self-efficacy test during learning ecosystem (Sigiro, Sigit, &

Komala, 2017). There are 21 students in one school in Kuta, who scored 68.83 on a low average of science self-efficacy during the implementation of project-based learning (Amanda, Subagia, & Tika, 2014). While 146 students which divided into an experimental group and control group, the normalized gain score obtained is 0,212 and 0,158 at the low category in science class (Wiratmaja, Sadia, & Suastra, 2014). However, self-efficacy should play a major role throughout the student's involvement in the school activity within the class (Dullas, 2018). This means it was not sufficient between the real data and the theories.

Another theory shows that every student's self-efficiency is different based upon each student's level of trust and capability in learning science (Dorfman & Fortus, 2019; Morony, Kleitman, Lee, & Stankov, 2013). Specifically, science self-efficacy is used in this research due to the science learning scope. According to the researcher's observation, there are several students in junior high school tend to ignore the teacher's instructions from the beginning, even they did not strive to understand the information that they have got. Thus, researchers chose science self-efficacy to be used as a variable according to the observation and data have shown.

Based on the consideration of the problems presented, need a solution to overcome the problem of learning. One alternative way to enhance problem-solving skills and science self-efficacy is by implementing STEM-based learning. The reason why STEM learning is the solution offered is that it provided a systematic conceptual model that doesn't provide a single problem-solving method but rather offers an idealized set that can integrate, modify and implement in a particular circumstance (Priemer et al., 2019). STEM learning could be applied in learning due to the importance of students' ability to compete for global issues, particularly in daily life problem-solving (Luthfiyani, Widodo, & Rochintaniawati, 2019). STEM offers guidelines for student to acquire and practice in real life by allowing individuals to use their knowledge and skill (Gustiani, Widodo, & Suwarma, 2017). It also offers a way to initiate students to new STEM fields by developing the basic skills needed in the 21st century (Farrington et al., 2012). Specifically, it can engage students to sharpen problem-solving skills (Struyf, De Loof, Boeve-de Pauw, & Van Petegem, 2019).

Another related study implementing STEM learning will inspire creativity, boost motivation, and enhance learning outcomes for students (Netwong, 2018). Students' engagement can achieve this during science education (Akerson et al., 2018). In simple terms, student involvement could be encouraged through fascinating those who describe as an experience-based, project-based, hands-on activity which incorporated over the subjects (Skinner, Saxton, Currie, & Shusterman, 2017). Furthermore, the implementation of STEM learning can make learning for students to get meaningful learning and learn about real life. (Khaerunnisa, 2017). STEM preparation is intended to assist students in planning for future careers as most future tasks require STEM comprehension. Since the new generation of innovators would deliver useful learning from STEM education (Saptarani, Widodo, & Purwianingsih, 2019).

Therefore, further research is needed on STEM learning to measure other variables that are deemed important to be implemented in the learning process. Since there have been many studies related to STEM learning but still focus on certain variables that analyze the effect of STEM learning on students' engineering skills (Damayanthy, 2017; Rusmana, 2017; Lestari, 2017; English, King, & Smeed, 2017). There is also study which focused on engineering design skills particularly on planting engineering (Nuryani, 2020). Further research from previous study is focused on detailed engineering designs and appropriate technology products for junior high school students (Arlingga, 2018). The previous research that measured the technological literacy abilities and decision-making skills of high school students used the STEM approach is also conducted (Luthfiyani, Widodo, & Rochintaniawati, 2019). Another study was done is STEM educational material will promote a better understanding of science, design and teamwork skills by students (Gustiani, 2016). Some studies explore the importance of applying STEM learning to develop the affective domain of students' creative disposition and creative thinking skill (Lim & Widodo, 2017; Hoeruni, 2017). There are also other studies that examine the STEM approach on the topic of environmental pollution, but the variables studied were student technological literacy and technology development skills (Fauziah, 2018). Therefore it is necessary to develop existing research with different variables.

Related study pieces have already been studied before on STEM learning, problem-solving skills, and science self-efficacy. The results show it gives students helpful instruction and guidance to try to understand the concept and boost those two variables in the study (Kohen, Amram, Dagan, & Miranda, 2019). STEM learning also can help both practice and study by having a shared context that relates to the methods, actions, procedures, and problem-solving application in the various areas to science (Priemer et al., 2020). STEM learning also important for students to be better work together, solve the problems, and the use of mathematics self-efficacy to improve authentic learning has the impact on their STEM future career (Blotnicky, Franz-Odendaal, French, & Joy, 2018). The results show the encourage self-efficacy in the selection of major and overall educational outcomes during the learning.

However, the world faces another situation today which forces us to adapt to new situations (Lourenco & Casey, 2013). The spread of the coronavirus (COVID-19) increased rapidly and resulted in major changes in many sectors, social interactions, and also becoming a major challenge for the educational field around the world. The COVID-19 pandemic impacted students' life in a range of ways. However, the impacts primarily cause many changes in the school system in a way that directs class turns into online learning from their houses (Murphy, 2020).

Thus, this research will provide experience in the STEM process by using online learning. Teachers and students can use existing social media platforms like Zoom, Google Meet, Cisco Webex, Whatsapp, and others to implement a distance learning program (Basilaia & Kvavadze, 2020). It will become a challenge to implement learning due to several factors such as instructional guidance, resources, time limitations, societal factors, networks are becoming external factors (Winne & Hadwin, 1998). The same resource shows the internal factors that will affect such as motivation, conviction, students' nature, and also the strategy used.

In this research, the use of problem-solving skills will be focused on scientific studies. Students are required to take the initiative and think about a problem systematically by using previously acquired knowledge and that will be linked to their daily issues, such as household waste. Students with different levels of performance work on a particular subject-specific environmental pollution

individually to study science through a problem-solving task or activity where the solutions and processes are needed to be found out (Leite & Durado, 2013). Furthermore, an instrument which might support students' problem-solving skill is reasonable to develop to measure the students' skill while solving the problem due to lack of resources to measure these variables in environmental pollution material.

Therefore, the environmental pollution topic is used because of the problems related to the environment generally occur. Then, children need an early introduction to how problems can be overcome by linking multiple knowledge such as science, technology, engineering, and mathematics by following the STEM learning stages (Murray, 2019). Students will learn how to deal with household waste problems around them, to practice their skills in the future to face real-world problems. Moreover, it is expected that by applying STEM learning, students can improve their self-efficacy in science learning. Since they must be optimistic, confident, and motivated to achieve the objectives directed by the instructor in their learning process even in a limited situation.

Further research can be implied from previous studies that have been explained. Not only strengthening students' problem-solving skills but also other factors that are said to be important to be involved in implementing STEM learning such as science self-efficacy. Unlike previous studies, STEM learning is implemented through an online learning strategy where students are personally involved in the activities provided related to environmental pollution problems that are guided directly by researchers in this study. Based on that thought, the researcher aims to research "The Impact of STEM-based Learning on Students' Problem-Solving Skill and Science Self-Efficacy".

1.2 Research Problem

According to the background stated, the research problem of this study is "How is the impact of STEM-Based Learning on students' problem-solving skill and science self-efficacy?". The research attempts to explore the following question to elaborate on the research problem:

1) How is the impact of STEM-Based Learning on students' problem-solving skills?
2) How is the impact of STEM-Based Learning on students' science self-efficacy?

1.3 Limitation of Problem

The issue is limited to making the study more concentrated as follows:

1) STEM learning

   STEM learning is concerning to prepare students for a world with advanced science and technology. The process of STEM learning in this research includes idea scoping, idea generation, construct and design, and evaluation (English & King, 2015). This research was conducted online to students in the application of STEM-based learning. Meanwhile, the learning was carried out by Whatsapp application, Zoom and also using google form as a form to fill the pre-test and post-test.

2) Problem-Solving Skill

   Specific cognitive processes are involved in the problem-solving process in this research consists of several aspects such as exploring problems, identifying problems, developing solution, making justification, and evaluation of problem-solving from the study of (Ghu, Chen, Zhu, & Lin, 2015; OECD, 2013).

3) Science Self Efficacy

   The proposed framework consisted of five dimensions of students' self-efficacy including conceptual understanding, higher-order cognitive skills, practical work, everyday application, and science communication (Lin & Tsai, 2013). While another dimension that is needed is a physiological state (Britner & Pajares, 2006). This study has concentrated on science self-efficacy since within the scope of science education (Dorfman & Fortus, 2019).

4) Environmental Pollution

   According to the Indonesian Curriculum, it will be taught in 7^{th} grade that is limited by Core Competence no. 3 and no. 4 also Basic Competence no. 3.8 and no. 4.8. Meanwhile, students will learn about definition, type, cause, and effects also the solutions to environmental pollution.

1.4 Research Objective

The aims of this research depending on the problem that was proposed are:

1) To investigate the impact of STEM-Based Learning on students' problem-solving skills.

2) To investigate the impact of STEM-Based Learning on students' science self-efficacy.

1.5 Research Benefit

The results of this study are expected to provide several beneficial aspects for:

1) Teachers

This research provided an alternative science learning in environmental pollution topics for students. It will assist teachers to get the chance to apply STEM-based Learning in their class. Particularly teachers help the students get used to familiar with the stages of learning that demands the use of skills for solving abilities for preparing the future. The study also provides insights for teachers on how students rely on science self-efficacy.

2) Students

This research may engage new experiences of studying science especially in learning environmental pollution for students. This research hopefully helps students by providing them with the knowledge to be equipped to practice the skills needed to overcome the problems during the implementation of STEM learning in the online process. The research also provided students' confidence in the ability of planning, managing, and carrying out a variety of behaviors to achieve the desired results in learning science.

3) Researchers

This research is to provide data for other studies to develop further research on how students' problem-solving skills and science self-efficacy besides other variables that have been previously investigated in the next research.

1.6 Organizational Structure of Research Paper

The organizational structure of this research refers to the guideline of Universitas Pendidikan Indonesia for writing scientific papers in 2019 which is divided into five chapters. The chapters are presented as the following:

1) Chapter I: Introduction

This chapter explains how research problems and research issues are identified and addressed as backgrounds. The problem of research is limited to the limitation of problems. The objectives of the research and benefits are described in this chapter.

2) Chapter II: Literature Review

This chapter discusses the theory and related research required to interpret the findings and results following the previous chapter. Some of the literature reviews affirm the whole study statement for analysis results in this paper. The literature reviews that included are problem-solving skill, self-efficacy, STEM learning, environmental pollution, and other relevant resources.

3) Chapter III: Research Methodology

The research method and design used in this research are described in detail in this chapter. In addition, it contains population sample, operational definition, research instrument, research procedure, data collection, data analysis technique, and research scheme also briefly explained for this research.

4) Chapter IV: Result and Discussion

Chapter IV contains explanations and discussion of the results in the research. This chapter addresses the outcomes and analyzes of this research.

5) Chapter V: Conclusion and Recommendation

This chapter includes research paper conclusions and future research recommendations.