CHAPTER I
INTRODUCTION

1.1 Background

The challenges and opportunities facing modern society is developing very rapidly, and it is also becoming increasingly important that the role of education is to prepare the nation's younger generation with either the varied knowledge and expertise required from a young age. The purpose of education in schools is that students can learn different social and emotional skills, not only the academic skills. Therefore, students can be more proactive in completing the challenge they face, and they can prepare themselves to develop their future (OECD, 2019b). Since 2007, Indonesia has actively worked to help the younger generation prepare for their future, becoming one of the five key partners in the OECD (Organization for Economic Co-operation and Development) (OECD, 2018). Nowadays, not only the competitiveness of the globalized economy of a nation that is essential to the growth of the country but also the growth of citizens' education. In order to help develop a global infrastructure for the assessment of human resources in education, PISA has been one of the OECD products with the most popularity (Sellar & Lingard, 2014).

The PISA (Program International Student Assessment) exam was attended by 79 countries in 2018. In total, 600.000 of 15-year-old students from all over the world are participating (OECD, 2019a). The science scores in Indonesia were reduced from the 2015 PISA test result based on the 2018 PISA test results announced on the 3rd of December 2019. In PISA 2018, Indonesia was ranked 72nd in reading scores, then mathematics scores were ranked 72nd, and science scores were ranked 70th (OECD, 2019a). All of these scores decreased equally from the 2015 PISA test. At that time, Indonesian reading scores were 65, math scores were 66, and science scores were 64 (OECD, 2016). There are certain aspects to the achievement of scientific literacy based on PISA results. Newer models of learning were suggested to ensure Indonesia’s standard of education in as a response to the challenges facing the world today (Fenanlampir, Batlolona & Imelda, 2019).

One of the solutions offered by the government to advance the educational system in Indonesia, particularly in student scientific literacy, was to revise the

Indonesian curriculum which previously called as KTSP (*Kurilulum Satuan Pendidikan*) or 2006 curriculum into National Curriculum or 2013 curriculum (Afriana, Permanasari & Fitriani, 2016). The 2013 curriculum has also undercut several changes in order to adapt to global developments leading to the challenges of the 21st century. The most important aspects of skills students need to master in 21st-century skills are learning aspects and innovation-4C's composed of critical thinking , communication, cooperation and creativity (Wibowo, 2014). One of the main educational tasks is to refine students' creativity, and to prevent falling behind the modern age. These creativity skills develop innovation, idea product invention, and idea solutions (Ozkan & Topsakal, 2019).

Gralewski and Karwowski (2018), in their study, stated that students' creativity factor is not something that comes naturally or instantly. The creativity ability of the students can also be built within and outside of school to create creative thinking or other creativity factors that develop all the time. Creativity skills focus on generating fresh and useful ideas and recognizing mistakes as a way of learning and applying improvements that contribute to any of the fields (Webb & Rule, 2014). The skills of student creativity can be viewed by process creativity or product creativity. Process creativity focused more on the development, while the result focused on product creativity (Fitriani, 2017). Most creative abilities are supported by knowledge as well as motivation to foster their creative skills (Rostan, 2010).

The Indonesian education system has, since the beginning of the 21st century, given priority to student-centered learning strategies particularly in comparison to teacher-centered learning strategies (Han et al., 2015). This is to encourage students to build their own knowledge on the information they receive, which is confirmed by the teacher. The theoretical background of STEM Project-Based Learning is constructivism in which students engage in various components of problem-solving, interdisciplinary curricula, open-ended questions, direct activities, group work, and interactive group activities leading to student-centered activities (Han & Capraro., 2015). As described by (Lou et al., 2017), One of the essential skills of 21st-century is personal creativity. STEM Project-Based Learning

provides a learning environment for students, designing a solution to the real-life problem to promote creative thinking and practical skills.

Furthermore, learning motivation of students is also an essential factor in educational development and encourages the creative skills of students. The Environment of Project-Based Learning can encourage students' learning motivation in many ways, for example, in formal and informal groups, regular monitoring meetings, and leadership sharing while doing the project (Chiang & Lee, 2016). Based on the interview with some of the students who mostly studied in public school, students still have difficulties in understanding the subject of physics. One of the influences is that the learning of physics in schools is generally carried out on a conventional basis only using concepts that are not being applied so that students get bored of physics. Heat transfer topics cover heat concept, heat transfer, and the application of heat transfer in daily life within the 2013 curriculum. These topics tend to be seen by mid-school students as abstract so that students need innovative learning to improve their creativity and motivation in learning physics.

A few other researchers have carried out various studies focused on implementation of STEM project-based learning in many areas, including research undertaken by (Lou et al., 2011), who examines students attitudes towards STEM-integrated project-based learning in the topic of Solar Energy. Another study measured the critical thinking of students on the subject of Water Pollution (Mutakinati, Anwari, Yoshisuke, 2018); the science literacy of students on Air Pollution topic (Afriana et al., 2016); and the imagination of student and the development of STEM knowledge among female high school students (Lou et al., 2014). Meanwhile (Samsudin et al., 2017) on their study analyze the distinction of students' achievement in the term of different gender and teaching method in the topic of physics mechanism.

Besides that, Lou et al., (2017) in their project made CaC_2 steamship that applied many physics concepts to it, and also Hanif, Wijaya & Winarno, (2019) explain that the project implemented throughout their research is simple projector that applied the principle of light and optics that focuses on the creativity study of the students. Nevertheless, in this study the researcher uses the principle of heat transfer to assess the students ' creativity and motivation by designing a simple heat

resistance system using the STEM project-based learning method. Therefore, researchers decided to carry out a study entitled "The Effect of STEM Project-Based Learning on Students Creativity and Motivation in Learning Heat Transfer."

1.2 Research Problem

The research problem in this study is "How is the effect of STEM Project-Based Learning on Students Creativity and Motivation in Learning Heat Transfer?". The research questions are concentrated on the previously mentioned research problems, such as:

1) How is the implementation of STEM project-based learning in learning heat transfer?
2) How is the profile of STEM project-based learning on student's creativity in learning heat transfer?
3) How is the effect of STEM project-based learning on student's motivation in learning heat transfer?

1.3 Research Objective

In accordance with the research question, the research objectives can be detailed as follows:

1) To get an overview of the implementation of the STEM project-based learning in learning heat transfer.
2) To examine the profile of STEM project-based learning on student's creativity in learning heat transfer.
3) To examine the effect of STEM project-based learning on student's motivation in learning heat transfer.

1.4 Research Benefit

The results of this study are expected to benefit both theoretically and practically for:

1) Teacher

This research is expected to be able to contribute to increasing teacher insight in learning Physics, especially in the heat transfer topic.

2) Students

This research is expected to help the students having learning experience in using STEM project-based learning to develop student's creativity and motivation in learning Physics, especially in the heat transfer topic.

3) Another Researcher

This research is expected to be an additional material to enrich the reference for other researchers.

1.5 Organizational Structure of Research Paper

In order to get the paper systematically structured, this research paper is arranged on the basis of the following organizational structure:

1) Chapter I: Introduction

This chapter will provide the background of this research, the problem of research, the objective of the research, the benefit of research, the organizational structure of research paper, and the limitation of the problem.

2) Chapter II: Literature Review

This chapter will present a literature review of some concept taken in this research which contains of STEM project-based learning, students' creativity, students' motivation, and hear energy concept.

3) Chapter III: Research Methodology

This chapter will explain about research method, research design, population and sample, assumption, research instrument, research procedure, instrument validation result, data processing, and operational definition.

4) Chapter IV: Result and Discussion

This chapter will provide the result and discussion of this research, which contain the implementation of STEM project-based learning, the profile of STEM project-based learning on students' creativity, and the effect of STEM project-based learning on students' motivation.

5) Chapter V: Conclusion and Suggestion

This chapter will describe about conclusion and recommendation of this research.

1.6 Limitation of Problem

Focusing the research problem more, the research will then be limited to as follows:

1) The implementation of STEM project-based learning in this research is conducted based on five steps of STEM project-based learning, which are preparation, implementation, presentation, evaluation, and correction (Lou et al., 2017).
2) The profile of STEM project-based learning on students' creativity is measured based on students' creativity in making a product. Based on (Treffinger, 1981), there are three kinds of creative product dimension, which are novelty, resolution, and elaboration and synthesis.
3) The effect of STEM project-based learning on students' motivation is investigate using a questionnaire of SMTSL (Students' Motivation towards Science Learning). Based on (Tuan et al., 2005) there are six aspects of students' motivation, which are self-efficacy, active learning strategy, science learning value, performance goal, and learning environment stimulation.
4) The topic in this research concentrated primarily on the topics of heat transfer based on the 2013 curriculum, which was constrained by core competency No.4 and core competency 4.4 for 7th grade (Kebudayaan, 2017).