

# CHAPTER I

## INTRODUCTION

### A. Background

Education is very important for the next generations' character. Education will create human resources that are able to build themselves and their nation, so the quality of education will be improved (Hariyadi, Utomo, & Wahyuni, 2014). In the modern era, education must be able to shape people to be productive, innovative, creative personalities and are able to contribute to the life of society, nation and state. Those skills has to be mastered by students so they can compete in this globalization era.

The globalization era is an era where the development of science and technology is very fast. Education certainly thinks about how to deal with the advancement of science and technology. This requires us to prepare ourselves to face it. Through education, human beings can obtain knowledge that can be used as a guide of life and education can shape human beings in having forward thinking and being able to compete in various fields. According to Buchori and Malik (2004), good education is education that does not only direct students to get a certain position or profession but to be able to solve problems in the real world so that they can be applied in daily life. In achieving the right educational goals, one of the factors that can facilitate the achievement of the educational goals is the presence of teaching materials that are appropriate to the needs and characteristics of students.

Nowadays, students have to involve more in the learning process. The teaching methods must be students centered and the teaching materials should support it. Also, teacher should encourage them by several teaching methods and also trigger them to be more exploring their thinking and more think creatively. The roles of teacher in the lesson also very influence the students' thinking like creative thinking. According to Ndeke, Okere and Keraro (2015), in teaching, science teacher should include scientific creativity, especially in their teaching

methodology. So, the teacher can teach the students by triggering the students to encourage the creative character of students can come out. Lucas, Claxton and Spencer (2014) stated that teaching should be carried out conducive for students to use their imagination, they need the confidence to believe that they could be imaginative. This will help teachers to identify the characteristics of creative students and encourage them and also provide a suitable environment for its development. The students should be more active, not only sit, pay attention to the teachers' explanation and writing but also should be more active like the statement of Saavedra and Opfer (2012) that students need to argue and the students need to get another way of learning not only the basic reading and writing, skills and knowledge across disciplines but also core competencies in critical thinking, creativity and innovation, problem solving, communication and collaboration.

The rapid development of science and technology made educators have to prepare students as the next generation who are competent in various fields. Competent fields are needed to deal with this, namely STEM (Science, Technology, Engineering, Mathematic). According to English and King (2015), STEM education aims to prepare students capable in scientific thinking and able to use technology to deal with the future. According to Avery and Reeve (2013), STEM education is an interdisciplinary approach to learning, in which students use science, technology, engineering, and mathematics in real contexts that connect between schools, the world of work, and the global world, so as to develop STEM literacy that enables students to compete in a new era. Research on STEM integration in project based learning is still rare. The results of Tseng *et al.*, (2013) revealed that STEM integrated project based learning can increase students' learning interest, learning becomes more meaningful, helping students in solving real-life problems, and supporting future careers. This STEM education has been developed in several developed countries but has not been too developed in Indonesia, only a few schools have implemented it.

The STEM approach is one of the most effective ways to encourage students to think high-level and problem-solving skills by placing mathematics and science in the context of technology and engineering (Jones, 2008). STEM-based learning

aims to prepare students who are more creative and use technology to solve related problems in real life. In STEM-based learning, students will carry out engineering process design. Engineering process design is a learning strategy that is useful for implementing STEM education in a 21st century curriculum (Crismond & Adams, 2012). With engineering, students will be trained to use their creativity in making a project as a solution to the problems found in everyday life. Creativity is important in the engineering process design. According to Suwarma *et al.* (2015), the process of engineering has several stages that can be done repeatedly as a cycle including: the process of exchanging ideas, designing, constructing, testing / evaluating and sharing solutions.

One of the supporting aspects of STEM learning is module. Module is one of the teaching materials that can enhance student's creative thinking and creative product. One of the 21<sup>st</sup> century skill that has to be mastered by students is creativity. According to Lou *et al.* (2017), One proper way to nurture creativity is to involve students in experiential activities that encourage active exploration through interdisciplinary curriculum integration and an orientation toward open and diversified subjects. Meaningful learning can be obtained through STEM approach that use STEM-based module as teaching material because according to Afriana (2016), in STEM learning, students have the opportunity to learn Science, Mathematics, and Engineering by overcoming problems that have applications in the real world. However, science modules for junior high school which fully contain STEM characteristics are rarely found in Indonesia. Mostly, these modules only contain science and mathematics, there is no technology and engineering component.

Less optimal in developing teaching materials and the limitations of science teaching materials in supporting integrated learning by teachers makes students unable to carry out the learning according to the characteristics of science and the needs of students. The importance of developing appropriate and effective teaching materials to facilitate students' needs in the form of modules in science subjects. According to Prastowo (2015), module is a teaching material that is arranged systematically which is should be easy to understood by students

according to the level of knowledge and age of students, in order to be able to be learned independently with minimal help or guidance from the teacher. Science learning materials such as module have to be made based on the development of technology and science itself. Modules as a tool for students in learning should have an impact on students' thinking skills so they can be applied in real life and also can improve student's 21st century skills such as creativity. One of research's result from Almuharomah *et al.* (2019) state that the STEM-based physics module integrates "*beduk*" local wisdom can improve creative thinking skills of students.

As a teacher, it is very important to allow the students to express their creativity. Creativity competence is being developed in the reworking of the Indonesian curriculum which holds students as the center of learning. It is also reflected in the 2013 curriculum which states students can present creations or projects for all subject area. But the problem is what learning models are suitable for improving students' creativity in science learning. According to Eliyawati *et al.* (2019), project-oriented problem-based learning (POPBL) with science, technology, engineering, and mathematics (STEM) integration can affect students' creativity in making product in learning science. Then, there are several ways to measure the students' creativity. The creativity of student also can be seen by their result of their product or their project making. According to Corazza and Agnoli (2016) history has shown that most of the important creative product produced at a young age. Product refers to an idea in a real form. A product can refer to physical objects, ideas, systems, services or processes.

The one of science topic that can be made STEM-based module to enhance creative thinking and creative product for Junior High School students is Sound wave. Sound wave topic can be taught by STEM-based approach and of course STEM-based sound wave module that can more involving the students in learning process because there's lot of experiment and observation on it. Those experiments can increase the knowledge of students and also student's thinking skills in learning sound wave. Then, Sound wave topic is needed to be taught to Junior High school eight grade students as stated in *Buku Siswa Ilmu Pengetahuan Alam Kelas VIII Semester II* that are attached in document of 2013 curriculum for

VIII grade of Junior High School Students. By learning sound wave, not only the cognitive of students that can be measure but also students' creativity. It is because there are several products that students can create by learning sound wave topic and the example is creating music instrument. The creativity of students can be measured by analyze their creative thinking and also their product.

Regarding to the background that has been represented and the needs of STEM learning implementation result in Indonesia, this research is focus on developing the structure of STEM-based module on sound wave topic to become a learning material to apply STEM in secondary level in Indonesia. Also, it will be use to analyze how the STEM-based sound wave module can improve students' creative thinking and creative product.

## **B. Research Problem**

Regarded with the background which already explained, the problem formulation of this research is "How is the developed STEM-based module on sound wave topic can enhance students' creative thinking and creative product?" Furthermore, the problem above is expanded through the following questions:

1. How is the characteristic of developed STEM-based module on sound wave topic?
2. How is the improvement of students' creative thinking through STEM-based module on sound wave topic?
3. How is the creativity of students' in making product through STEM-based module on sound wave topic?

## **C. Research Objectives**

The aims of this research are as follow:

1. To produce STEM-based module on sound wave topic that can enhance students' creative thinking and creativity in making product.
2. To investigate the effectiveness of STEM-based module on sound wave topic through the improvement of students' creative thinking.

3. To investigate the effectiveness of STEM-based module on sound wave topic through students' creativity in making product.

#### **D. Research Benefits**

The results of this research are expected to provide the benefits as follow:

1. Teacher

This research can be useful as an alternative teaching material that can be used by teachers in science learning on the topic of sound wave while practicing the skills of designing and making a product using the concept of sound wave. Then, helping teachers in adding information and insight in creating more innovative learning strategies.

2. Students

This research can help students practice the skills of designing and assembling simple tools through STEM module. Then also help students develop abilities in the engineering process design to practice their creative thinking skills.

3. Another Researcher

This research might inspire other researcher to make a research about the STEM-based module as teaching materials but to learn another topic in science or maybe another subject and also using another method of teaching.

#### **E. Organization Structure of Research Paper**

The structure of this research paper consist of five chapters:

1. Chapter I. Introduction. This chapter contains the background of the research, research problem, research objectives, research benefits, organizational structure of research paper and limitation of problem.
2. Chapter II. Literature Review. This chapter contains literature review about STEM, Instructional Teaching material or Module, Creative thinking, Creativity Product, Sound Wave, and relevant research.
3. Chapter III. Reseach Methodology. This chapter contains the method that is used to finish this research paper, which are research method and research design, participants of research, operational definition, research instrument,

data collection, instrument analysis, data collecting, data analysis technique, research procedure, and research scheme.

4. Chapter IV. Results and Discussion. This chapter contains the results as well as the discussion of this research paper.
5. Chapter V. Conclusion and Recommendation. This chapter contains the conclusion of research paper as well as the recommendation for future research.

## **F. Limitation of Problem**

In order to make the research become more focused, the problem is limited as follow:

1. The developed STEM-based module was following the outline criteria to fulfil the needs of developing good STEM learning material based on 8 steps of science and engineering practices from Bybee (2011) namely ask questions and define problems, develop and use models or examples, plan and conduct an investigation, analysis and interpretation of data, using mathematical and computational thinking, develop explanations and design solutions, engaging in argumentation and evidence.
2. Creative thinking skills that measured include aspects of fluency, flexibility, originality in thinking, the ability to elaborate (develop, enrich, detail), and evaluation which those idea made by Munandar (1999).
3. Students creativity product that is measured involve three creativity dimensions, i.e novelty, resolution, and elaboration and synthesis that stated by Basemer and Treffinger (1981).
4. The concept sound wave for VIII grade refers to *Kurikulum* 2013 on Basic Competence 3.11 (Analyze the concepts of vibration, waves, and sounds in everyday life including the human hearing system and sonar systems in animals) and 4.11 (Presenting the results of experiments on vibrations, waves, and sounds).