CHAPTER I
INTRODUCTION

1.1 Research Background

In the 21st century, the world faces various global issues closely related to everyday life. Considering the complexity of the problems and issues faced, the ability to integrate knowledge and tackle real problems is needed (Chen et al., 2019). In this regard, integrating science, technology, engineering, and mathematics (STEM) was developed as an approach to learning (Psycharis, 2016). Through STEM-based learning, knowledge, and skills can be obtained through problem-solving, which can help students prepare for real life and solve problems in life or work (Ralls et al., 2020). One of the goals of STEM education is to develop 21st-century skills for individuals (Nation & Hansen, 2021). 21st-century skills provide meaning, and deep understanding as well as the transfer of knowledge between disciplines (Acedo & Hughes, 2014). One type of 21st-century skill students need is the ability to think creatively. This creative thinking process is obtained from the interaction between talent, process, and environment, individually or in groups, to produce a product seen as new and useful in a social context (Lai & Viering, 2012). Some researchers argue that external support, such as environmental and cultural factors, play an important role in developing students' creative potential (Dunlop et al., 2018; Henriksen et al., 2021; Pllana, 2019; Sanabria & Arámburo-Lizárraga, 2017). One form of support can involve students in an activity, project, or learning model that is appropriate to explore their creative potential.

Previous researchers have conducted various studies integrating STEM into learning models to train students' creative thinking skills. As conducted by (Hsiao et al., 2017), who integrated the design thinking model with STEM for mechatronics learning at the high school level. The results showed that there was a significant difference between before and after the implementation of the strategy. Students' problem-solving skills improved, and students could provide ideas in the form of designs from the solutions to the problems they encountered. The same results were also shown in a study conducted by (Ruamcharoen et al., 2021), who used problem-based learning to introduce the topic of polymer materials to final-

year students majoring in science. In addition, (Luqmanul Hakim et al., 2019) used project-based learning in learning mathematics for junior and senior high school students. The results show that the implementation of project-based learning has yet to be maximized, and the meager mindset of students when solving problems in mathematics learning. However, there is an increase in terms of creative thinking skills. Nevertheless, the study should have revealed a more detailed analysis of how applying the learning model can improve students' creative thinking skills.

In addition to being applied to school learning, (Wang et al., 2019) successfully applied STEM to the megaGEMS Research Camp training for undergraduate female students. The results showed that participants who participated in the activity could more easily understand the learning process, and the integration of STEM could create practical activities and a supportive learning community. Similar research (Pei & Ling, 2020) through the Low-Cost Educational Robotics Car Project, which 76 undergraduate students attended, showed that the activity could foster participants' interest in STEM and train their 21st-century skills. However, both studies have yet to reach the stage where participants provide further innovation/ design ideas for what has been done or provide ideas for real problem-solving.

Based on the problems studied by previous researchers, the writer tries to look at students' creative thinking skills from another perspective. Through this research, it can be seen how students' skills in developing new ideas, designing innovative solutions, and solving problems around them creatively in the context of robotics. This process encourages students to think innovatively, face technical challenges, and collaborate in developing creative and functional solutions. This study aims to determine students' creative thinking skills in STEM-based Robotics activities at the secondary education level and their responses regarding STEM learning.

1.2 Research Question

Based on the background described previously, several problem formulations were made in this study. The formulation of the problem includes:

1. How are students' creative thinking skills in generating product design ideas?
2. How are the students' creative thinking performances in terms of creative thinking criteria?
3. How do students respond to STEM-based robotics activities?

1.3 Research Purposes

Based on the background and problem formulation described earlier, the objectives of this study are to find out:

1. Students' creative thinking skills through product design ideas developed.
2. The performances of students' creative thinking skills in terms of creative thinking criteria.
3. Students' responses to STEM-based robotics activities.

1.4 Scope of Problem

To focus the research, the scope of the problem in this study are as follows:

1. There were six schools that became research locations with details of two junior high schools, two senior high schools, and two vocational high schools located in West Java, Indonesia.
2. Indicators of student creative thinking assessment are seen from the results of design ideas made by students during the activity in groups, and individual creative thinking performance is observed through the engineering design process and creative thinking criteria.

1.5 Benefits/Significant of Research

The expected benefits of this research can provide benefits both theoretical and practical. The theoretical benefit is providing readers with information for further research with similar studies on STEM implementation at the secondary education level—especially the application of STEM applied to Robotics learning and its relation to creative thinking. The practical benefit of this research is that it

can be used as a reference for educators in applying STEM to learning activities to train students' creative thinking skills.

1.6 Thesis Organizational Structure

The preparation of this thesis research report refers to the Guidelines for Writing Scientific Works of Universitas Pendidikan Indonesia in 2019, which consists of five chapters. Chapter 1 includes the research background, research question, research purposes, the scope of the problem, benefits/ significance, and thesis organizational structure. Chapter 2 contains a literature review of theories on applying STEM-based learning and robotics learning, the engineering design process, and creative thinking skills. Chapter 3 describes the flow of exposure to research methods, including research design, participants, research instruments, research procedures, data collection techniques, and data analysis techniques. Chapter 4 discusses the results of the discussion and findings of the research that has been conducted to answer the research questions that have been formulated previously. Chapter 5 contains research conclusions, recommendations, and implications for further research on similar topics.