CHAPTER I
INTRODUCTION

1.1 Background

The era of the 21st century is generally recognized as the era of technology. The existence of technology has evolved into a vital tool for humans to keep informed by nearly endless information and stay connected to each other in a single click. Technology plays a crucial part in every possible field in our lives, and education is one of them (Al-Saqqa et al., 2014). In this techno-centric era, education is challenged to produce excellent human resources (Laisa, 2019). As modern educators, we should connect our way of teaching with technology and get our students to master the set of 21st-century skills to meet that competitive demands and challenges (Argina & Desi, 2017).

One of the skills that have an important place in the 21st century is computational thinking (Mohaghegh & McCauley, 2016). Computational thinking can be defined as the process of breaking down complex problem into smaller ones that we know how to solve (Mcclelland & Grata, 2018). A complex problem is a problem that consists of many sub-problems. Anyone with computational thinking skills will find it easier to handle real-life problems and challenges (Kalelioglu et al., 2016). In other words, computational thinking is a problem-solving pattern that connects ideas, facts, and logic through various disciplines as if it is computer operation (Qualls & Sherrell, 2010). As computers and technology now become important resources for the thinking process in the 21st century, computational thinking allows us to not only consume technology but also to create with technology (Park & Jeon, 2015; Yadav et al., 2016). Despite the fact that computational thinking covers a variety of mental skills that reflect computer science, it represents an applicable attitude and skill that everyone, not only computer scientists, would be eager to use (Wing, 2006).

Before computational thinking skills are being performed in real life, students have to understand the concept and application through their classroom activity first. Computational thinking assists students to develop their conceptual and

analytical thinking as well as solve complex problems by choosing appropriate tools and strategies (Park & Jeon, 2015). Examples of complex problems can be seen on the Programme for International Student Assessment (PISA) test items. As Indonesian students' PISA result is always significantly below the average of OECD countries, it can be said that they are still lacking of complex problem-solving ability (Sulistiyo & Wijaya, 2020). Computational thinking is also considered to be fundamental for students in this era because it includes teamwork and collaboration skills, critical thinking skills, and problem-solving skills (Barrington et al., 2006). Those skills are in line with the 21st-century learning environment that expects learners to possess both self-direction and the ability to collaborate with individuals, groups, and machines (McCoog, 2008). By means to collaborate students with machines (technology), the integration of curriculum and learning activities with technology should be done (Yadav et al., 2016).

In this digital era, the way students visually brainstorm and organize ideas and information has been upgraded from paper mindmap into digital ones (Karim & Mustapha, 2020). Digital mind mapping was found to be able to improve students' critical thinking and decision-making (Baksh et al., 2016). Mind mapping is an innovative learning method that helps students boost a new environment in information processing (Rezapour-Nasrabad, 2019). As a digital tool, digital mind map could integrate ideas with relevant symbols, colors, or pictures which help students facilitate the ideation process (Karim & Mustapha, 2020). It helps students to heighten visual learning to construct their existing knowledge (Safar et al., 2014). Furthermore, by doing digital mind mapping, students may minimize the difficulty of making sense of concepts learned at school and correlating them with the new concept, which is one of the most common issues they faced (Murat Debbag et al., 2021).

The ideas of computational thinking are ubiquitous and can be applied across wide disciplines, including science courses such as biology, chemistry, and physics (Yadav et al., 2017). Furthermore, the necessity of computational thinking as a science education purpose is becoming more widely recognized (Swanson et al., 2019). Teaching computational thinking in the context of science not only gives students a more realistic picture of science today, but it also gives them more access

to strong modes of thinking and skills that are useful in a variety of fields (Mohaghegh & McCauley, 2016).

In addition to implement computational thinking with creating a digital mindmap, the topic chosen for this research is global warming. Global warming is an environmental problem that is increasingly felt in various parts of the world (Suryansyah et al., 2021). Nowadays, students require both a strong knowledge around overcoming global warming and a strong set of skills that can apply their knowledge in the real world such as problem-solving skills (Kwauk & Winthrop, 2021). A previous study mentioned that Indonesian students are still lacking the knowledge and way to solve the impacts of global warming (Rosidin & Suyatna, 2017). This topic is also important as the basic understanding to face real-life environmental challenges.

From the explanation above, this research contributes to the application of the concept of computational thinking skills in science learning with a non-programming or coding approach but by creating digital mind map. Computational thinking that well-known as a complex problem-solving skill is expressed by the students on their creation of digital mind map. The science topic raised in this study is global warming, considering the importance of the environmental issue as well as experimentally using computational thinking and digital mindmap to help students solve the problems (Yadav et al., 2016).

1.2 Research Problem

The research problem of this study is "How is the use of digital mindmap to enhance students' computational thinking in learning Global Warming?"

1.3 Research Question

Elaborating the research problem, the research attempts to explore the following questions:

a) How is the implementation of digital mind map to enhance students' computational thinking in learning global warming?
b) How is the difference between students' computational thinking in experimental class that created digital mind map and control class that created paper mind map in learning global warming?

c) Is there any correlation between students' mind map score and computational thinking score?

1.4 Research Limitation

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

a) Students computational thinking

Computational thinking is a concept of solving a complex problem by dividing it into the smaller manageable parts. Students' computational thinking in this research consists of four strands of computational thinking practice, which are: Decomposition, Pattern Recognition, Abstraction, and Algorithm.

b) Digital mindmap

Digital mind map in this research is limited to the digital visualization of students' comprehension and ideas about the topic. Digital mindmap is a computer-generated mindmap. Students use Creately.com as the tool to create a digital mindmap and a mindmap rubric used to measure students' digital mind mapping skills.

c) The topic in the research is limited to Global Warming for the 7^{th} grader. The sub-topics include the greenhouse effect, Global Warming process, factors and impacts of Global Warming, and overcoming Global Warming. On the 2013 Indonesia National Curriculum, this topic is attached on the basic competence no. 3.9 and 4.9, while the core competence is only focused on no. 3 and 4.

1.5 Research Objective

This research is conducted to analyze the use of digital mind map to enhance students' computational thinking in learning about global warming. The objectives of this research are as follows:

a) To investigate the implementation of digital mind map to enhance students' computational thinking in learning global warming

b) To investigate the enhancement of students' computational thinking after creating digital and paper mind map in learning global warming

c) To investigate the students' mind map score correlation with students' computational thinking score in learning global warming

1.6 Research Benefit

The result of this research is expected to give a good input as follows:

a) Students

Students are able to make digital mindmap to be presented publicly. During the process of creating the digital mindmap, students are expected to improve their computational thinking in order to help them to solve a complex daily life problem. Also, the skill of digital mind mapping could be used in their work field in the future.

b) Teachers

Teachers are able to implement digital mindmap to assist their learning process, especially in a topic that requires problem-solving skills. Digital mindmap can also hopefully be used as a media to assess students' computational thinking.

c) Researchers

Results of this study are expected as a reference and additional exposure in introducing students to computational thinking as well as using digital mindmap as a learning tool and in learning science.

1.7 Organizational Structure of Research Paper

a) Chapter I: Introduction

This chapter includes background, research problem, research questions, research limitation, research objectives, and research benefits.

b) Chapter II: Literature Review

Chapter II explains the literature review about theories that applied to this research. The theories are about computational thinking, digital mindmap, Global Warming, and previous relevant research relates to the topic of this research.

c) Chapter III: Research Methodology

This chapter explains and describes the methods, which were used and applied in this research. This chapter also explains in detail the research method,

research design, population and sample, hypothesis, assumption, data analysis, research instrument, and research procedure.

d) Chapter IV: Result and Discussion

The chapter focuses on the data gathered while this research was conducted. It describes detailed information on how this research analysis and processes the finding data, which can be used to answer the research question of this research.

e) Chapter V: Conclusion and Recommendation

This chapter states the conclusion after all the data gathered, processed, and analyzed. It states the recommendation in order to give any suggestion to another researcher in the future.