

CHAPTER I

INTRODUCTION

1.1. Background of Study

The development of this world is very increasingly rapid and complex in the 21st century which is marked by the era of the industrial revolution 4.0, especially in Indonesia (Hermawati *et al.*, 2021; Harahap & Rafika, 2020). This revolution can be characterized by the integration of technology by blurring the boundaries of physical, digital, and biological spaces. Currently all human activities are being transformed from manual to digital (Xu *et al.*, 2018). Along with the times, learning technology has developed significantly and adapts to the current developments. The use of digital technology in classroom has not resulted in significant changes and improvements in the learning process in the classroom (Berrocoso *et al.*, 2021).

Advances in science and technology have both positive and negative impacts on human life (Astuti & Dewi, 2021). The positive impact arises because of the various facilities that can improve the quality of human life, both in education and daily life. Meanwhile, there are some real examples of negative impacts, namely the energy crisis, noise pollution, and the feeling of the environment (Jamun, 2018).

Students as part of a global society, really need to be involved to answer these problems. Therefore, students need to be equipped with the ability to care and be responsive to issues that develop in society to plan problem-solving and have in-depth knowledge and understanding to be applied in problem-solving. This can be achieved if students have scientific literacy (OECD, 2019). Students who know to understand scientific facts and the relationship between science, technology, and society, also can apply their knowledge to solve real-life problems are called scientifically literate people (Pradini *et al.*, 2022). Given the importance of scientific literacy, educating the public so that scientific literacy is the main goal in any educational reform (Munawaroh *et al.*, 2022).

Scientific literacy is the ability that can engage with science-related issues, and with ideas of scientific as a reflective citizen (OECD, 2018). The notion of scientific literacy is reinforced by Sutrisna & Anhar (2019), which states scientific

literacy is the knowledge and understanding about scientific concepts, and process that enable some person to make informed decisions and is important for students, so that they not only understand science as a concept but can also apply science in their daily life. Gu *et al.*, (2019) stated that scientific literacy cannot be ignored and must always be explored to students, because it helps them make the right decisions, solve individual and universal problems, and achieve science learning goals, besides that scientific literacy is also important to face and keep up with increasingly sophisticated technological developments (Fausan *et al.*, 2021).

Scientific literacy consists of 3 dimensions, there are the content dimension (science knowledge), the process dimension (scientific competence), and the context dimension (science application) (Zahro *et al.*, 2021). The aspects of competence in scientific literacy divided into three, there are explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting scientific data and evidence (Saraswati *et al.*, 2021).

Programme for International Student Assessment (PISA) is an international study of achievement in reading, mathematics and scientific literacy specifically for students aged 15 years. The PISA program is implemented by the Organization for Economic Co-operation and Development (OECD) which is carried out every 3 years, starting from 2000 and estimated end in 2030 (Nugrahanto & Zuchdi, 2019).

PISA determines the criteria for selecting science content as follows: relevant to real-life situations, is important knowledge so that its use is long-term and appropriate for the developmental level of children aged 15 years or equivalent to junior high school students (Putri, 2021). At the junior high school level, learning science is one of the lessons that occupies very important role because science can provide students with provisions in dealing with advances in science and technology in the 21st-century era. Therefore, science learning in schools expected be able to apply scientific literacy in learning (Mentari, 2021).

Mijaya *et al.*, (2019) stated that junior high school students in the learning process were not facilitated for scientific literacy, because teachers still applied conventional learning. In the situation at school, science in learning still emphasizes only product aspects without developing process aspects, such as only

memorizing concepts, principles, and formulas, whereas in the 2013 Curriculum students are expected to be able to solve problems.

Natural science as part of education plays an important role in preparing students who have scientific literacy, namely those who can think critically, creatively, analogically and take the initiative in responding to issues in society caused by the impact of the development of science and technology (Pratiwi *et al.*, 2019). However, science learning currently does not apply learning that supports the development of students' scientific literacy (Yuliati, 2017).

The results of achieving student scientific literacy skills in Indonesia on PISA still low from year to year. In 2009 Indonesia was ranked 61th out of 65 countries with a score of 383, in 2012 Indonesia was ranked 64th out of 65 countries with a score of 382 (OECD, 2013), in 2015 Indonesia was ranked 69th out of 79 countries with a score of 403 (OECD, 2016) and in 2015 Indonesia was ranked 71th out of 78 countries with a score of 396 (OECD, 2019). Based on the public education report 2022 in North Sumatera, Medan city there are the results table of achievement of literacy skills, the results of the acquisition of literacy skills in 2022 junior high schools in Medan city are presented in Table 1.1.

Table 1.1 Public Education Report 2022 in Medan

Achievements	Indicator (Literacy Skills)	Description
Below minimum competence	The ability of students to understand, use, evaluate, reflect on various types of texts to solve problems and develop individual capacities as Indonesian citizens and citizens of the world so that they can contribute productively in society.	Less than 50% of students have reached minimum competency limit for literacy.

(Pusmendik, 2022)

Based on that data, it can be understood, the scientific literacy ability of Indonesia students is still low when compared to international average score and is at a low level from the PISA measurement. This is an urgency that must be resolved and a solution is found at this time.

One of the contexts tested on PISA is the human digestive system. Human digestive system is a complex combination of the versatile and multi-scale physicochemical process (Sensoy, 2021). The human digestive system is a material that discusses the mechanism of human digestion in processing food substances that enter the body through the digestive tract. The material of the human digestive system is a difficult subject because the study of its physiological processes is abstract (Harahap & Ristiono, 2019). The research of Sinaga *et al.*, (2019) stated some students still have difficulty in science learning with the material about human digestive system. The factors that most influence students learning difficulties in understanding the human digestive system lie in internal factors and external factors, namely teaching materials and learning media which are still minimal and not interactive.

The low scientific literacy ability of students is caused by several factors. These factors include the lack of use of books, school infrastructure, curriculum, methods and learning models (Purwani *et al.*, 2018). Another factor that affects students scientific literacy skills is the teacher (Fakhriyah *et al.*, 2017). Based on Ardan's (2016) research, it is said that teachers tend to use printed books or conventional teaching materials more in interpreting and understanding the material, so that the content of the material in the book does not expand and focuses on the material being taught.

Based on the problem of the lack of scientific literacy skills and understanding the material of the human digestive system. So, it is necessary to use teaching materials that help to learn by utilizing the role of technology in the form of electronic devices. The role of electronic teaching materials can move the interest of students to be active and independent and improve the ability of scientific literacy competencies (Mijaya *et al.*, 2021). Teaching materials can make students feel excited in getting material or information (Rahmani *et al.*, 2021). The weakness of the current learning process is in addition of the lack of teacher competence in learning, but the lack of innovation in learning resources/teaching materials used in learning, so that students are less able to master the material properly and correctly when learning (Farhana *et al.*, 2021).

Electronic book (E-book) are innovative and interactive teaching materials in digital form and new trends in various parts of the world, which have advantages compared to conventional books in general (Huda, 2021). E-book are becoming part of the academic mainstream (Casselden & Pears, 2020). E-book are digitally published books, converted to electronic format from printed paper. E-book can be accessed, read on mobile devices (Alsalmi *et al.*, 2020).

The use of E-book can show a positive response to interest in learning, especially in increasing students scientific literacy (Taufaliyati *et al.*, 2020; Aswirna & Ritonga, 2020). This is reinforced by Ozturk (2021) which states that, E-book can improve students scientific literacy skills, and language skills in terms word recognition, and fluency in learning. Based on Yuberti *et al.*, (2022) research, it is said the interactive in an E-book have potential benefit of assisting students in improving students scientific literacy skills. E-book must be interactive, because interactive E-book make learning remains students-centered, so they can understand the content well, can improve their scientific literacy skills, students can study deeply and are able to apply knowledge to real, new, and different condition and situation (Firdausy & Prasetyo, 2020).

Overcoming the problem of weak scientific literacy is very appropriate if using appropriate teaching materials, in addition to teaching materials, learning approaches can also affect the students scientific literacy skills, and can encourage students to be able improve scientific literacy skills (Yuliati, 2017). Science learning has the potential to improve scientific literacy by integrating science, technology, engineering, and mathematics (STEM) approaches (Listiana *et al.*, 2019; Sole, 2021).

STEM is a learning approach that involves students in exploring real-world problems and contexts, by utilizing the capabilities of the four disciplines of science, technology, engineering, and mathematics (Macdonald *et al.*, 2020). STEM learning approach has become an interdisciplinary approach around the world that is combined with real-world learning in context to make connections between schools, especially to prepare students for the challenges of the 21st century (Parmin & Sajidan, 2019).

The application of the STEM-based learning approach for students scientific literacy is very good, because it can encourage students to be able to learn through exploration, investigation, and problem solving (Aswirna *et al.*, 2022). E-book STEM-based are electronic teaching materials that integrate concepts, technology, engineering, and mathematics simultaneously in one material (Widayoko *et al.*, 2018). E-book STEM-based can improve students scientific literacy competence, because E-book STEM-based can encourage students to learn through exploration, investigation, and problem solving for students in learning process (Prabawati & Agustika 2020).

The results of observations and interviews for the first stage of ADDIE there is analysis in the field the data showed that school used K-13 for the learning process, for the score of AKM showed in Appendix and then the low scientific literacy skills of students were caused by teachers still using conventional books in learning, teaching methods that still used the lecture method, and the lack of books that support learning available in the classroom to improve students scientific literacy. These factors supported by Purwani *et al.*, (2018) research, state the lack of use of books, school infrastructure, curriculum, methods and learning models is a factor that causes low scientific literacy.

Based on this problems, researcher decided to research and development of teaching materials in form of E-book STEM-based as electronic teaching materials to carried out that can improve students scientific literacy skills on the material of the human digestive system by using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) development model.

Development is carried out by analyzing constraints and needs, designing the product to be produced, developing the product, implementing it by conducting trials, and the final stage is an evaluation of the resulting product. It is hoped that with the development of E-book STEM-based, the resulting product can not only improve students scientific literacy skills which are classified as low, but can be a guide for teachers in developing teaching materials that can be used in learning. These problems make researcher interested to conducting this research with title **“Development of E-book STEM-based on Human Digestive System Material to Improve Scientific Literacy Skill”**.

1.2. Identification of Problems

Based on the background of the problem above, several problems can be identified as follows:

1. Scientific literacy ability of students based on PISA and public education report 2022 in junior high school results is still low.
2. Lack of practicality of conventional teaching materials in the form of printed books used as a source of student learning.
3. Lack of development of electronic teaching materials to improve students scientific literacy.
4. Teachers still use conventional teaching materials in the form of printed books that are used as a source of student learning.
5. Students have difficulty in understanding the concept of the human digestive system material.

1.3. Problem Limitation

So that this research is more focused, the researchers limit the research problems as follows:

1. The research method used is Analysis, Design, Development, Implementation, and Evaluation (ADDIE) development research method.
2. The scientific literacy aspect used is limited to the competence aspect, namely explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting scientific data and evidence.
3. The evaluation stage in the effectiveness of the E-book STEM-based can only be seen from the results of the N-gain obtained.

1.4. Problem Formulation

The formulation of this research problems as follows:

1. How is the feasibility of E-book STEM-based be based on material expert?
2. How is the feasibility of E-book STEM-based be based on media expert?
3. How is the feasibility of E-book STEM-based be based on learning design expert?
4. How is the feasibility of E-book STEM-based be based on linguist expert?
5. How is the practicality of E-book STEM-based be based on teachers responses?

6. How is the practicality of E-book STEM-based in terms of the implementation of students responses?
7. How is the effectiveness of E-book STEM-based on human digestive system materials to improve students scientific literacy skill?

1.5. Research Objectives

In accordance with the formulation of the problems, the objectives of this research are:

1. Knowing the feasibility of E-book STEM-based be based on material expert.
2. Knowing the feasibility of E-book STEM-based be based on media expert.
3. Knowing the feasibility of E-book STEM-based be on learning design expert.
4. Knowing the feasibility of E-book STEM-based be based on linguist expert.
5. Knowing the practicality of E-book STEM-based be based on teachers responses.
6. Knowing the practicality of E-book STEM-based in terms of the implementation of students responses.
7. Knowing the effectiveness of E-book STEM-based on the material of the human digestive system to improve students scientific literacy skill.

1.6. Benefits of Research

The benefits or contributions obtained from this research can be described as follows:

a. Theoritive Contributions

The results of this study are expected to increase and expand the repertoire of knowledge about scientific literacy in science lessons, as well as increase knowledge about the importance of scientific literacy, especially science subjects for the human digestive system material.

b. Practical Contributions

1. **For students**, this research is expected that students after learning by using E-book STEM-based teaching materials can improve students scientific literacy on the material of the human digestive system.
2. **For teachers**, this research in expected to be a references in developing E-book STEM-based teaching materials to improve students scientific literacy.

3. **For schools**, this research is expected to be used as an evaluation material for learning in schools related to the effectiveness of learning teaching materials used by teachers in science learning, especially in the material of the human digestive system.
4. **For researcher**, this research provides direct experience in developing E-book STEM-based to improve scientific literacy skills on digestive system materials in class VIII junior high school.

1.7. Operational Definition

Operational definition to understand the terms used in this study as follows:

1. 21st century learning is learning that refers to the development of learning, literacy and life skills as part of the classroom experience.
2. Scientific literacy is knowledge and understanding of scientific concepts and process that can enable a person to make informed decisions and be able to play an active role in all aspects of life.
3. Programme International Student Assessment (PISA) is an international study of achievement in reading, mathematics and scientific literacy. The PISA program is implemented by the Organization for Economic Cooperation and Development (OECD).
4. One of the electronic-based teaching materials is an electronic book (E-book). E-book are described as books published digitally, or converted to electronic format from printed paper. E-book can be accessed on mobile devices.
5. STEM is a learning approach that involves students in exploring problems and real-world contexts, by utilizing the abilities of four disciplines of science, technology, engineering, and mathematics.
6. E-book STEM-based are electronic teaching materials that integrate science, technology, engineering, and mathematics simultaneously in one material.
7. The digestive system is one of the learning materials studied in science subjects for class VIII junior high school, which contains the processes carried out by the digestive organ system to process food so that it can absorb nutrients and convert food into energy.