

CHAPTER I

INTRODUCTION

1.1 Background of The Problem

The significant impact of development in the 21st century has changed human life. In the 21st century, everyone is required to have various skills to compete in an ever-changing era. If the implementation of education prepares students to master the various skills needed, then these skill requirements can be fulfilled. This indicates that education has an important impact on building the progress of the country in the present and the future (Septiani et al., 2019).

The needs of the 21st century require every individual to have various skills, namely creative thinking, problem solving, and communication skills. When students want to compete in the era of globalization, they must have the ability to communicate, collaborate, think critically, and be creative, or what is known as 4C skills. (Hermansyah, 2020). One of the government's efforts to answer the challenges of the 21st century is to develop a curriculum. The 2013 curriculum has undergone several revisions. The 2017 curriculum, which was revised in 2013, contains several important points, including improving character education (PPK), 4C skills (critical thinking, creativity, collaboration, and communication), and Higher Order Thinking Skills (HOTS). In addition, literacy is included in the 2013 curriculum revision, namely the School Literacy Movement (SML). Therefore, the 2013 curriculum requires students to be able to master technology and changing times (Putri et al., 2019).

One of these skills is critical thinking. Critical thinking plays an important role in education and is the main goal of learning. With adequate critical thinking skills, mastery of content and the application of each lesson in everyday life can be mastered (Fitriani & Setiawan, 2017). According to PISA (Program for International Student Assessment) data (2018), Indonesia ranks very low in student achievement in science at 69 out of 77 countries (PISA, 2018). Meanwhile, based on TIMSS data (Trends in International Mathematics and Science Study), Indonesia is in a very low rank, namely 44 out of 47 countries which shows that the cognitive ability of mathematics and science material is very

low. (TIMSS, 2015). Based on these facts, it can be concluded that the knowledge of science concepts in Indonesia is very low (Walfajri & Harjono, 2019).

Many branches of knowledge are taught in schools. One of them is Natural Sciences (IPA). The purpose of learning science is to develop critical thinking skills, scientific skills, and conceptual knowledge. In science learning, students must be able to find relationships in equations and then connect concepts with life around them (Rohmah & Nurita, 2017). An important element in learning science is being able to obtain products and processes, so that critical thinking can be raised. Through the ability to think critically, a person can make the right decisions. Even critical thinking skills greatly affect one's future life, so critical thinking can be used as a tool for success in this global era of the 21st century (Hidayati et al., 2021). Based on this, SMP/MTs need to cultivate a culture of science learning to think critically, creatively and think scientifically (Bunt & Gouws, 2020). Critical thinking involves analysis and evaluation, not just accepting ideas or information. This includes understanding relationships, similarities and differences, finding patterns, classifying, understanding reasons/results, observing trends and big ideas, predicting outcomes, considering multiple perspectives, making evaluations and asking questions and reasons (Sumarni et al., 2019).

Based on the results of observations as pre-research activities carried out by researchers on class VIII students on science material at SMP Negeri 35 Medan by using questionnaires, it is found that the implementation of science learning by teachers is still dominant using the lecture method and student center with the answers "Always" and "Often" got the most responses. Then students are still not familiar with the critical thinking ability test. This can be seen from the giving of tests to measure critical thinking skills by teachers who received the most responses, namely "Never" and "Sometimes". This fact is also supported by the results of the critical thinking ability test for class VIII students in the first semester of science material on the Human Digestive System material by researchers, The results obtained that students' critical thinking skills are still very low. With an average value of 32,16. This indicates that science learning carried out in schools does not support students to have critical thinking skills.

Low critical thinking skills can occur because learning only focuses on material with a system of memorizing concepts but not applying them directly, so they do not have the opportunity to analyze problems, identify, summarize or propose ideas or even provide new solutions to certain problems. Learning does not encourage students to think critically (Fithri et al., 2021).

Students' critical thinking skills can be improved with appropriate learning methods and approaches. One of the learning approaches that have succeeded in improving critical thinking skills is the STEM (Science, Technology, Engineering, and Mathematics) approach. (Changtong et al., 2020). The STEM approach itself is an innovative learning approach with the aim of developing science skills, technology skills, engineering, and mathematics to prepare students who can compete globally (Wisudawati, 2018). This approach is an alternative in learning science as well as training critical thinking skills. This is because the STEM approach in the learning process trains students to develop science, technology, engineering science and mathematics skills for problem solving, building competence and tolerance (Parmin et al., 2020).

Natural Science requires mathematics as a tool to process data, while technology and engineering are applications of science. Based on research (Simatupang et al., 2020) the students' worksheet design based on the STEM approach which is integrated with the Project-based learning model gets a percentage value Validation of experts $\geq 75\%$ with the average getting the appropriate criteria and the results of using the worksheet were able to grow critical thinking skills with a score of 82.57 with very high criteria. This is also confirmed by research (Khofifah & Mitarlis, 2021) validation results from experts on students' worksheet who use the STEM approach and with project-based learning models on acid and base material get a percentage score in the very good category and increase students' critical thinking skills with an N-gain score of 0.84 with a very high category and stated effective. Based on this, the students' worksheet developed with a STEM orientation with the PjBL model is feasible to use in learning. $\geq 90\%$.

One of the science subjects is the human excretory system which requires more understanding because the basic concepts are abstract and the processes that

occur in it are quite difficult for students to understand (Pada et al., 2021). The Human Excretion System is one of the science materials that is recommended to use the PjBL model to develop critical thinking skills and prepare students for the 21st century. This material is studied in SMP/MTs grade VIII even semesters in the 2013 Curriculum (Trimawati et al., 2020).

Critical thinking can be developed through the application of the Project Based Learning (PjBL) learning model with the STEM approach. This model links students' improved critical thinking skills with teamwork. Learning with this model focuses students in learning and integrating concepts to solve problems. Learning is carried out through the division of small groups to foster students' ideas and opinions in completing projects. In the application of this model, the teacher is more passive, so students can learn a lot through experience in making products (Sayekti & Suparman, 2020). The PjBL-STEM relationship can be used as an innovative learning system that requires students in the PjBL learning model to create projects or tools, while STEM is a component with interdisciplinary relationships (Rahmania, 2021).

The realization of learning objectives cannot be separated from the role of teachers, learning media, learning resources such as handouts, student books and students' worksheet. Students' worksheet is one of the sources of student learning that is used as a guide in the process of problem solving and investigative activities. Learning models and learning resources in the form of teaching materials and students' worksheet based on the STEM approach are able to have a good impact. One of them is improving critical thinking skills and understanding concepts (Yulianah & Fauziah, 2020).

Students' worksheet is one of the important things because it serves as a learning resource. Learning resources can be developed by teachers to help students acquire knowledge in learning activities. The researcher also conducted direct interviews with the VIII grade science teacher at SMP Negeri 35 Medan. He said that the current students' worksheet applied was less attractive and less effective in improving students' critical thinking skills. Teachers need worksheets that are innovative and effective in improving science learning in schools. Therefore, it is necessary to do a SWOT (Strength, Weakness, Opportunities,

Threats) analysis to see the situation, problems and efforts that can be made to overcome the above problems. SWOT analysis is a method for analyzing certain situations to evaluate internal and external problems and conditions consisting of Strengths, Weaknesses, Opportunities, and Threats (Rochman, 2019).

Based on the SWOT analysis on the students' worksheet sourced from the Ministry of Education and Culture's science textbooks used by SMP Negeri 35 Medan, the results of the analysis in terms of "strength" are the textbooks used by the Ministry of Education and Culture. and Culture so that the quality is guaranteed, it has been checked by professionals. so this book has been used for a long time so its application is very mature. Then there is discourse, the images presented are attractive, using standard language and easy to reach. In terms of "weaknesses" it was found that students' worksheet had not motivated students to develop students' critical thinking skills, students' worksheet had not been developed using an innovative approach based on STEM (Science, Technology, Engineering, Mathematics). then the final form of students' worksheet is not project-based (real tool), then the results of each stage of implementation of activities in students' worksheet are not visible. From the perspective of "Opportunity", the results show that the book has been mass-published and has become a mandatory book for all junior high schools that have been used for several years. while in terms of "Threats" it was found that several activities in the students' worksheet require tools and materials that are difficult to buy and obtain, so that their implementation is limited because they can only be carried out in the school environment. then the activities on the implementation of the students' worksheet have been around for a long time so that the latest innovative activities are getting more and more updated.

STEM-based learning involves students to play an active role in the teaching and learning process. This based learning can help students solve problems and then get conclusions through the learning carried out. Solving this problem is obtained by applying the learning that has been obtained through Science, Technology, Engineering, Mathematics. The application of this knowledge produces students who have problem-solving skills in learning and in everyday life (Lou et al., 2017) . STEM-based learning can be done with learning resources

that contain study guides in the form of student worksheets (Agustina et al., 2021). STEM-based learning can be implemented with learning resources that contain study guides in the form of students' worksheet (Wirdani et al., 2019). Therefore, it is necessary to develop worksheets to provide learning resources that help students. One of the advantages of developing student's worksheet is its design that can be adapted to the circumstances of students and school conditions. Innovative worksheets can make students concentrate on learning. STEM is one of the learning approaches used in developing worksheets. With this approach, the teacher invites students to solve problems, create innovations in new designs, master technology and think critically (Yunita, 2021).

Research result (Khofifah & Mitarlis, 2021) stated that the students' worksheet developed was based on a project-based learning model that was integrated with the STEM approach and was suitable for use in learning. Where the feasibility of the students' worksheet is seen from the validity of the results and the validity of the content, each showing a percentage score of 92.95% and 91.15% in the very good category. This is in accordance with research (Simatupang et al., 2020) the results of the use of students' worksheet based on the STEM approach were made able to grow students' critical thinking skills where the average score obtained by students was 82.57% complete. (Lestari et al., 2018) stated that the students' worksheet with the STEM approach was able to help students to improve their critical thinking skills. Experimental and project activities on the students' worksheet will present great opportunities for independent learning and create more active and critical students.

Based on the background of the problems presented, researchers are interested in conducting research with the title "Development of STEM-Based Student Worksheets (Science, Technology, Engineering, Mathematics) to Improve Critical Thinking Skills in Human Excretion System Materials for Class VIII Junior High School".

1.2 Scope of The Problem

The scope of development is needed in conducting research to facilitate researchers in focusing research. The scope of this research is as follows:

1. The students' worksheet developed is based on PJBL-STEM on the material of the human excretory system.
2. This students' worksheet is intended for class VIII SMP Negeri 35 Medan.
3. The type of research used in this research is Research & Development (R&D) by developing LKPD with the ADDIE model.
4. This research is limited to students' critical thinking skills
5. The critical thinking indicator used in this study is Ennis (1989) which focuses on questions, adjusts to the source, induces and considers the results of induction, defines terms and considers them and interacts with other people with a total of 5 critical thinking questions.

1.3 Formulation of The Problem

Based on the description of the background that has been described, the following problems can be identified:

1. How is the feasibility of students' worksheet based on STEM Science, Technology, Engineering, Mathematics) can improve critical thinking skills in the human excretory system material for class VIII SMP according to material experts and linguist & learning experts ?
2. What is the effectiveness of using students' worksheet based on STEM Science, Technology, Engineering, Mathematics) in improving students' critical thinking skills on excretory system material in humans ?
3. What is teacher and student responses of using students' worksheet based on STEM Science, Technology, Engineering, Mathematics) in improve critical thinking skills in the human excretory system material for class VIII SMP?

1.4 Limitation of The Problem

Based on the identification of the problems that have been described, the researcher provides boundaries so that they are not too broad and do not deviate from the research objectives, and are directed and the goals can be achieved. The limitations of the problem in this study are as follows:

1. Testing the feasibility of students' worksheet based on STEM Science, Technology, Engineering, Mathematics) can improve critical thinking skills in the human excretory system material for class VIII SMP according to material experts and linguist & learning experts.

2. Knowing the effectiveness of using students' worksheet based on STEM Science, Technology, Engineering, Mathematics) in improving students' critical thinking skills on excretory system material in humans.
3. Knowing the teacher's and the student's response of using students' worksheet based on STEM Science, Technology, Engineering, Mathematics) in improve critical thinking skills in the human excretory system material for class VIII SMP?

1.5 Research Purposes

The purposes of this research are as follows:

1. Knowing the feasibility of students' worksheet based on STEM Science, Technology, Engineering, Mathematics) can improve critical thinking skills in the human excretory system material for class VIII SMP according to material experts and linguist & learning experts.
2. Knowing the effectiveness of using students' worksheet based on STEM Science, Technology, Engineering, Mathematics) in improving students' critical thinking skills on excretory system material in humans.
3. Knowing the teacher's and the student's response of using students' worksheet based on STEM Science, Technology, Engineering, Mathematics) in improve critical thinking skills in the human excretory system material for class VIII SMP

1.6 Benefits of Research

The benefits of this research are twofold, theoretically and practically, as follows:

1. Theoretical Benefits

The results of this study are expected to contribute to science education, especially in the development of teaching materials as well as reference materials in STEM-based Student Worksheets in science learning so that students are more active in participating in learning.

2. Practical Benefits

- a. For researchers, the results of this study can add insight to researchers as prospective educators to improve the ability to develop teaching materials that are able to prepare students to compete in the future education system.

- b. For schools, the results of this research can contribute in the form of teaching materials that are used to improve the quality of learning and improve the quality of graduates for school progress.
- c. For teachers, the results of this study can provide a choice of more innovative teaching material references in developing STEM-based worksheets that are able to improve students' critical thinking skills.
- d. For students, the results of this study can provide alternative teaching materials that can provide student-centered learning so that learning is more interesting and able to develop students' critical thinking skills and be able to apply them in everyday life.

1.7 Operational Definition

1. Student's Worksheets are a series of task sheets and experiments in the form of teaching materials that are used as a guide for students to carry out learning. The students' worksheet used in this study is STEM-based in the human excretory system material.
2. STEM (Science, Technology, Engineering, Mathematics) is one type of learning approach. This approach integrates the learning process between materials and skills such as science, technology, engineering and mathematics which are combined in an integrated unit. The STEM approach is very suitable to be applied with the Project Based Learning learning model.
3. PjBL Learning Model (Project Based Learning) is a learning model that aims to produce products through a learning process and is student-centered. This model is implemented collaboratively or in groups. Critical thinking skills can be developed with this learning model. PjBL Steps according to Hosnan & Sikumbang in (Azizah & Widjajanti, 2019) generally consist of: (1) project determination; (2) design of project completion steps; (3) preparation of the project implementation schedule; (4) project completion with teacher facilitation and monitoring; (5) preparation of reports and presentation/publication of project results; (6) project evaluation and project results.
4. Critical Thinking Ability is a skill to get a valid conclusion through analyzing and evaluating information. The critical thinking indicator used in this study is

Ennis (1989) namely focusing questions, adjusting to sources, inducing and considering the results of induction, defining terms and considering them. and interact with other people with 5 critical thinking questions.



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