

CHAPTER I

INTRODUCTION

1.1. Background of the Problem

Mathematics learning has an important role in the educational environment. This is because mathematics is a universal science that underlies the development of modern technology and has an important role in various scientific disciplines to advance human thinking. As a result, mathematics is used as a compulsory subject in the Indonesian education curriculum for students from elementary to high school.

Curriculum 13 is in line with learning objectives in the 21st century, including: (1) critical thinking and problem solving; (2) creativity and innovation; (3) communications; and (4) collaboration. Based on Permendikbud Number 36 of 2018 (2018), the goals of mathematics subjects in schools for primary and secondary education include so that students can: (1) Use patterns as conjectures in problem solving and be able to make generalizations based on existing phenomena or data. (2) using reasoning on properties, performing mathematical manipulations both in simplification and in analyzing the existing components in problem solving. (3) Communicating ideas, reasoning, and being able to compile mathematical proofs by using complete sentences, symbols, tables, diagrams, or other media to clarify situations or problems In addition, the learning objectives according to the Pancasila profile are as follows: 1) to have faith, fear God Almighty, and have noble character; 2) to be independent; 3) to collaborate; 4) to embrace global diversity; 5) to use critical reasoning; and 6) to be creative (Kemendikbud Ristek, 2021).

One of the focuses in learning mathematics is critical thinking (Amalia & Pujiastuti, 2017). Critical thinking is the ability to think clearly and rationally, which includes the ability to think reflectively and independently, the ability to

analyze facts, generate and organize ideas, defend opinions, make comparisons, draw conclusions, evaluate arguments, and solve problems (Surip, 2014). Furthermore, according to Nuryanti et al. (2018), critical thinking is a basic clarification ability, a basis for making decisions, concluding, providing further explanation, estimation, and integration, as well as additional abilities. Furthermore, Mason (2008) argues that critical thinking is an ability based on certain skills, such as the ability to assess reasons correctly, to weigh relevant evidence, or to identify erroneous arguments. Therefore, it can be concluded that critical thinking is an ability to think effectively that can help someone make, evaluate, and make decisions about what to believe or do.

Critical thinking ability have great benefits for students. One of the benefits of critical thinking in learning is that it can minimize the occurrence of errors when solving problems, so that in the end a solution with the right conclusions will be obtained (Sulistiani, 2006). Another benefit is that a critical thinker is able to analyze and evaluate any information he receives (Nuryanti et al., 2018). In line with the opinion of Prihartini et al. (2016), which states that critical thinking ability can help someone sort out relevant information, It can be concluded that this ability is very useful for solving problems and doing bigger tasks. In addition, the ability to think critically will help someone think and work more thoroughly.

Critical thinking ability is one of the abilities that must be developed at this time. One way to develop critical thinking ability is by learning mathematics. This opinion is supported by Julita (2014). This is because in learning mathematics, the principles used can develop consistent and accurate reasoning so that it can be used as an effective thinking tool to look at various problems in mathematics or outside of mathematics. Therefore, learning mathematics should be maximized to be able to improve critical thinking ability.

However, the facts show that the mathematical critical thinking ability of Indonesian students are still in the low category. Based on the results of an international study on the mathematics achievement of Indonesian students conducted by the Trends in Mathematics and Science Study (TIMSS) in 2015, it showed that Indonesia was ranked 44th out of 49 countries with an average score

of 397 out of an international average score of 500. This result experienced a downgrade from the TIMSS results in 2011, which were ranked 38th out of 42 countries (Mullies et.al., 2015).

The Programme for International Student Assessment (PISA) data released by the Organization for Economic Co-operation and Development (OECD) in 2018 also placed Indonesia in the 73rd place of 79 countries with an average of 379 from the OECD average of 489. The data show that Indonesia's average score is still below average. The rankings of Indonesia from year to year are also not much different and are still below the other countries (OECD, 2018).

The fact that the critical thinking ability of students in Indonesia is low is also supported by the diagnostic test results of students in X-1 grade at High School Negeri 12 Medan, who have critical thinking ability that belong to the low category. The diagnostic test results of one of the students are listed as follows:

Table 1. 1 Results of one of the students' responses to the diagnostic test

	Data :
<input type="checkbox"/>	Suatu kebun binatang terdapat burung unta dan jerapah sebanyak 50 ekor. Jika diabaikan jumlah kaki-kaki dan binatang tersebut
<input type="checkbox"/>	sebanyak 140. dalam sehari setiap burung unta menghabiskan wortel sebanyak 2 kg, sedang kan setiap jerapah menghabiskan 3 kg setiap harinya. maka berapa kg wortel yang harus dipersiapkan
<input type="checkbox"/>	Untuk kedua binatang setiap harinya?
<input type="checkbox"/>	Jawab : $x = \text{unta}$
<input type="checkbox"/>	$y = \text{Jerapah}$
<input type="checkbox"/>	$2x = \text{hewan kaki 2}$
<input type="checkbox"/>	$4y = \text{hewan kaki 4}$
<input type="checkbox"/>	$x + y = 50 \dots (1)$
<input type="checkbox"/>	$2x + 4y = 140 \dots (2)$
<input type="checkbox"/>	Eliminasi pers 1 ke pers 2
<input type="checkbox"/>	$\begin{array}{r} x + y = 50 \\ 2x + 4y = 140 \end{array} \left\{ \begin{array}{l} \times 2 \\ \times 1 \end{array} \right. \begin{array}{l} 2x + 2y = 100 \\ 2x + 4y = 140 \\ \hline -2y = -40 \\ y = 20 \end{array}$
<input type="checkbox"/>	Subst $y = 20$ ke pers 1
<input type="checkbox"/>	$x + y = 50$
<input type="checkbox"/>	$x + 20 = 50$
<input type="checkbox"/>	$x = 50 - 20$
<input type="checkbox"/>	$= 30$
<input type="checkbox"/>	maka unta = 30 ekor
<input type="checkbox"/>	Jerapah = 20 ekor

Figure 1. 1 Answer of one of the students for a diagnostic test

<p>1. Elementary clarification (giving a simple explanation)</p> <p>From the solution given by the student, student has not identified the problem by giving focus to the element of the problem, so in the solution to the question, the student still writes the question back and has not made what is known and asked from the question.</p>
<p>2. Advance clarification (giving further explanation)</p> <p>From the solution given by the student, student has already identified the connections of concepts in the problem and constructed them into mathematical models with accurate descriptions.</p>
<p>3. Strategies and tactics (defining strategy and techniques)</p> <p>From the solution provided by the student, student has already used the accuracy of the strategy in solving the problem, as well as precision in the calculation, but because the student has not been able to identify the problems, student does not answer the question as a whole.</p>
<p>4. Inference (concluded)</p> <p>From the conclusions given by the student, student has not been able to draw the conclusion obtained.</p>

The answer process above shows that the student is less able to understand the questions given. The same problem was also found in other student answer sheets, which revealed that students' critical thinking ability were still classified at the lower level. This was obtained based on the results of a diagnostic test, where there were 11.11% of students who were in the very high category for critical thinking ability, 19.44% in the high category, 25% in the sufficient category, 27.78% in the low category, and the rest in the very low category.

Based on the results of observations at SMA Negeri 12 Medan, several obstacles were found in the process of learning mathematics. The first obstacle is that the process of learning mathematics in these schools is still semi conventional. The semi conventional learning still used is teacher-centered. Learning activities are more dominated by teachers, so in the learning process, students are more

passive. Learning in semi conventional way cannot optimally develop students' critical thinking ability.

Teacher-centered learning used in the learning process causes low student critical thinking ability. This is in line with research (Julita, 2014; Liberna, 2015; Safrudin, 2014), which states that the ability to think mathematically is still low due to ongoing learning that is still one-way or teacher-centered. In addition, students are not given the opportunity to analyze or come up with new ideas. Students are also given less opportunity to relate to the abilities they already have (Syahbana, 2012).

The second obstacle is that some students consider mathematics to be a lesson that is less interesting. They also think that mathematics is a subject that is identical with formulas and numbers that are difficult to understand. This is because learning mathematics in schools is rarely associated with real-life examples in everyday life. The learning given by the teacher is still expository, where students are given definitions, principles, concepts, and examples of questions.

In line with Santoso (2017), who states that most students experience difficulties applying mathematics to real life, it is difficult for students to apply mathematics in real life because learning mathematics is less meaningful. So that students do not experience difficulties in applying mathematics, learning must be meaningful for them. Teachers teaching mathematics in the classroom must relate their learning to the schemes that are already owned by students, and students must be given the opportunity to reinvent and construct these mathematical ideas themselves (Kusnadi, 2023).

To present a real atmosphere in the learning process, a contextual learning approach is needed. This is in line with the opinion of Sanjaya (2016), Contextual Teaching and Learning (CTL) is a learning strategy that emphasizes the process of full student involvement to be able to find the material being studied and relate it to real life situations so as to encourage students to be able to apply it in their lives. Contextual Teaching and Learning (CTL) is a teaching system that fits the brain because it generates meaning by connecting academic content with the context of students' daily lives (Johnson, 2011). It can be concluded that Contextual Teaching

and Learning (CTL) is learning that relates material to real life situations and emphasizes students to be actively involved in discovering the material.

The third obstacle is that teachers rarely use electronic media during the learning process. The teacher only uses whiteboards and markers during the learning process. In addition, sometimes teachers use school facilities such as projectors to display material from PowerPoint. It can be concluded that teachers rarely use electronic media during learning.

In line with the opinion of Latuheru (1988) states that learning media are all tools (auxiliaries) or objects used for teaching and learning activities, with the intention of conveying messages (information) learning from sources (teachers or other sources) to recipients (in this case students or learning citizens). Sadiman (2008) explains that learning media is anything that can be used to transmit messages from the sender to the recipient of the message. In this case, it is the process of stimulating the thoughts, feelings, concerns, and attention of students so that the learning process can be intertwined. Furthermore Putri et al. (2019) stated that learning media is a messenger technology that can be used for learning purposes. So it can be concluded that learning media is a teaching aid to convey material so that messages are more easily received and make students more motivated and active.

There are several benefits of learning media. Sudjana & Rivai (2010) explained that learning media can improve the process and learning outcomes of students. There are several reasons why this happens, including : (1) Learning using media will attract more students' interest so as to foster their learning motivation, (2) learning material will be more meaningful so students will understand the material and learning objectives well, (3) using teacher learning methods are more varied, not only verbal communication through the delivery of teacher lectures, so as to create two-way or interactive learning, (4) student activities will be not only listening to the teacher, but students can carry out other activities such as discussing, observing, demonstrating, doing, and so on. Learning media can also increase student motivation to learn, encourage students to write, speak and imagine (Nurfadhillah, 2021). Thus, through learning media can make the teaching and

learning process more effective and efficient and establish good relations between teachers and students. In addition, learning media can also play a role in overcoming boredom in learning in class.

It is also known that the school has not used relevant student worksheets to improve critical thinking ability. Mathematics learning in schools only relies on teaching materials in the form of textbooks and student worksheets to support the teaching and learning process. Student Worksheets provided by schools tend to be sources of information. The student worksheets only consist of material explanations, sample questions and practice questions. In addition, student worksheets are not equipped with examples of application in everyday life, so that when linked to everyday life students are less able to understand the material. So that student worksheets that are currently available have not been able to facilitate students optimally in the learning process, especially to improve students' critical thinking ability.

Based on interviews with several class X-1 students of SMA Negeri 12 Medan, it can be seen that the printed worksheets used did not interest them. The available student worksheets are less creative and innovative. The student worksheets only consist of text and images. This causes their lack of motivation to learn, which results in low learning outcomes in the form of critical thinking ability. If this condition is allowed to continue, this can affect the mindset and attitude of students.

Based on this explanation, it is necessary to develop varied and interesting worksheets, which pay attention to the principles of a contextual approach to improve students' critical thinking ability. According to Umbaryati (2016) student worksheets were chosen because they can stimulate students to be active in the learning process, help develop concepts, practice finding, and develop process skills, as a guide for educators and students. In line with the results of research conducted by Shanti et al. (2018) concluded that student worksheets based on the Contextual Teaching and Learning (CTL) approach are very supportive for fostering students' critical thinking ability. From these findings, it is hoped that

student worksheets combined with a contextual approach will be able to improve students' critical thinking ability.

In the industrial era 4.0 which emphasized the availability of learning resources in digital form, one of them is digital student worksheets. According to Farkhati (2019) digital student worksheets are sheets that contain instructions for carrying out tasks that must be done by students in learning with reference to Basic Competencies through digital or the internet. Digital student worksheets are digital learning tools as exercises that can be accessed easily via PCs, laptops or smartphones. Data in digital student worksheets can be supported with images, audio, video and animation (Zahroh & Yuliani, 2021). Based on the explanation above, it can be concluded that the digital student worksheet is a teaching material containing a summary of learning material and questions, in electronic form in the form of images, audio, video and animation that move according to the competencies to be achieved.

Digital student worksheets have an important role in learning so that students do not only receive them in finished form but seek for themselves by contributing to the learning process (Prastika & Masniladevi, 2021). According to (Farkhati, 2019) digital student worksheets play a role in improving student learning outcomes. Digital student worksheets are used so that learning is more effective and students don't feel bored due to the help of electronic devices which are used as a means to assist and facilitate teaching and learning activities and can increase student learning activities and achievements.

The results of previous research showed that digital student worksheets using the CTL approach were able to improve students' critical thinking ability with an n-gain value of 0.86 (high) (Lestari & Muchlis, 2021). In addition, Arifin & Sepriyani (2019) also conducted research with the conclusion that CTL-based digital student worksheets were able to improve critical thinking ability with an n-gain value of 0.44-1.00 with medium-high criteria. This can prove that digital student worksheets with the CTL approach can improve students' critical thinking ability.

Based on the results of initial observations at SMA Negeri 12 Medan, it can be concluded that students' critical thinking ability are low. So that by using digital student worksheets based on CTL (Contextual Teaching and Learning) It is hoped that it can help students follow the mathematics learning process and improve students' critical thinking ability.

Based on this background, it is necessary to conduct development research with the title "**Development of Digital Student Worksheets Based on Contextual Teaching and Learning to Improve Students' Critical Thinking Ability in High School**".

1.2. Identification of Problem

Based on the background of the problems above, the identification of problems in this study are as follows :

1. Students' critical thinking ability are still relatively low, especially students in class X at SMA Negeri 12 Medan.
2. Learning mathematics at SMA Negeri 12 Medan still uses semi conventional learning.
3. The learning process at SMA Negeri 12 Medan has not linked it to the context of everyday life.
4. There are no Contextual Teaching and Learning-based digital student worksheets that fulfil the aspects of validity, practicality, and effectiveness that can be used to improve students' critical thinking ability.
5. The learning process in class has not optimized the use of technology.

1.3. Scope of Problem

Based on the background of the problem and identification of the problem described above, the scope of this research is in class X-1 SMA Negeri 12 Medan with a total of 36 students. Students will be given learning using digital student worksheets on probability material based on Contextual Teaching and Learning which stimulates to improve students' critical thinking ability. This school is located at Jalan Cempaka No. 75 Medan.

1.4. Limitation of Problem

To avoid widening the problems in this study, it is necessary to disclose the problem. This research is limited to several things, namely as follows :

1. Students' critical thinking ability, especially class X students at SMA Negeri 12 Medan, are still relatively low.
2. Learning mathematics at SMA Negeri 12 Medan is rarely associated with real examples in everyday life.
3. There is no contextual teaching and learning-based digital worksheet to stimulate students' critical thinking ability in class X SMA Negeri 12 Medan which fulfills the aspects of validity, practicality, and effectiveness.

1.5. Formulation of Problem

Based on the background, problem identification, and problem boundaries that have been stated above, the formulation of the problem in this study is as follows:

1. How are students' critical thinking ability after using digital student worksheets based on Contextual Teaching and Learning?
2. Does the quality of digital student worksheets that have been developed based on Contextual Teaching and Learning to improve students' critical thinking ability fulfil the aspects of validity?
3. Does the quality of digital student worksheets that have been developed based on Contextual Teaching and Learning to improve students' critical thinking ability fulfil the aspects of practicality?
4. Does the quality of digital student worksheets that have been developed based on Contextual Teaching and Learning to improve students' critical thinking ability fulfil the aspects of effectiveness?

1.6. Objectives of Study

Based on the formulation of the problem above, the objectives in this study are to:

1. To describe students' critical thinking ability after using digital student worksheets based on Contextual Teaching and Learning.
2. To find out the quality of digital student worksheets that have been developed based on Contextual Teaching and Learning to improve students' critical thinking ability that fulfil the aspects of validity.
3. To find out the quality of digital student worksheets that have been developed based on Contextual Teaching and Learning to improve students' critical thinking ability that fulfil the aspects of practicality.
4. To find out the quality of digital student worksheets that have been developed based on Contextual Teaching and Learning to improve students' critical thinking ability that fulfil the aspects of effectiveness.

1.7. Benefit of Research

The benefits obtained in this study include theoretical and practical.

1.7.1. Theoretical Benefits

This research is expected to be able to contribute to learning mathematics, especially in terms of improving students' critical thinking ability by using digital worksheets based on Contextual Teaching and Learning. Learning.

1.7.2. Practical Benefits

a. For Student

1. Digital student worksheets based on Contextual Teaching and Learning are expected to improve students' critical thinking ability in mathematics lessons.
2. Digital student worksheets based on Contextual Teaching and Learning can foster students' motivation and interest in learning mathematics.

3. Digital student worksheets based on Contextual Teaching and Learning can make it easier for students to understand the concepts in mathematics lessons
- b. For Teacher
 1. Digital student worksheets based on Contextual Teaching and Learning can make it easier for teachers to deliver mathematics learning material.
 2. Digital student worksheets based on Contextual Teaching and Learning can be used by teachers as a reference for learning mathematics that is interesting, fun, effective and efficient.
 - c. For School
 1. Digital student worksheets based on Contextual Teaching and Learning can be used as input in improving the quality of learning in mathematics.
 - d. For Researchers
 1. As a consideration for prospective educators to be more creative in using student worksheets in learning mathematics as an effort to improve learning outcomes.
 2. Provide references for the next batch of students to conduct further research.