

CHAPTER I

INTRODUCTION

1.1 Background of The Problem

The rapid progress of science and technology in the 21st century is something that cannot be avoided. One of the fields that benefit from the development of science and technology is the world of education (Setiabudi et al., 2022:33). In this regard, P21 (Partnership for 21st Century Learning) has described a learning structure where the teaching and learning process is not just mastery of concepts, but must equip students with skills in utilizing information technology and media, life and career skills, and learning and innovation skills (Listiyani, 2021).

21st century learning that emphasizes learning skills that must be instilled in students including critical thinking, creative thinking, communication, and collaboration. In line with this, Arnyana (2019) describes the four abilities, namely (1) collaboration, namely the ability to work together, synergize with one another, adjust to different jobs, and appreciate differences, (2) communication, namely the ability to communicate ideas, concepts, new information and knowledge possessed either verbally or non-verbally, (3) critical thinking, namely the ability to solve a problem or make choices related to the problem at hand, and (4) creativity, namely the ability to produce new concepts or concepts that are different from previous concepts. Critical thinking skills or critical thinking are abilities that must be mastered so that students can think, describe, solve problems and express opinions based on the information they have learned (Aliftika 2019:27). His understanding of the information obtained by interpreting statements in textbooks, journals, discussion partners, including teacher statements during the teaching and learning process can improve critical thinking skills (Saputra, 2020:15).

Based on the findings of the international research PISA (Program for International Student), the critical thinking skills of Indonesian students in general are still quite low. The PISA test is used to measure science, math and reading skills. Based on the 2018 PISA results, Indonesian students obtained an average math score of 379, ranking 73rd out of 79 countries. The PISA results in 2022 showed that the average student math score was 366, ranking 70th out of 79 countries. The next research is TIMSS (Trend in International Mathematics and Science Study).

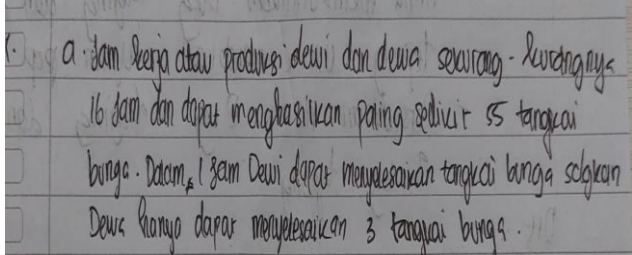
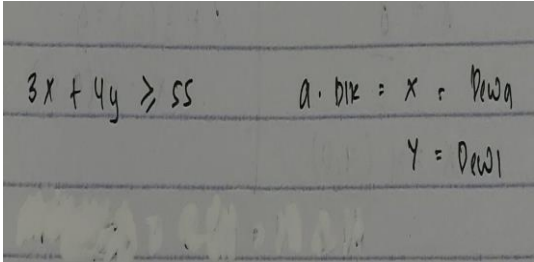
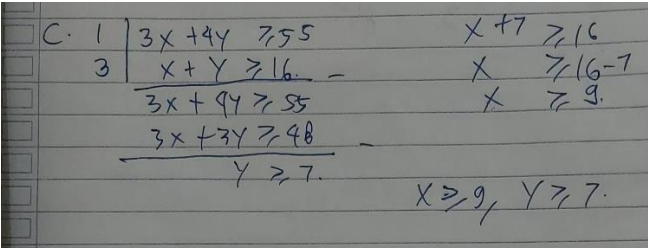
The results of the Trends in International Mathematics and Science Study (TIMSS) in 2021 stated that the mathematics literacy score of students in Indonesia ranked 44 out of 49 countries with a score of 397 according to Nizam (in Junaidi (2017:49)). With the TIMSS criteria dividing the survey participants' scores into four levels: low with a score of 400 (low), medium with a score of 475 (intermediate), high with a score of 550 (high) and advanced with a score of 625 (advanced) from the data above Indonesia occupies a low criterion. Utami, et al., (2021:23) stated that the questions used in the TIMSS study are questions that require higher-order thinking skills, including critical thinking, in solving problems. The results of the PISA and TIMSS studies show that the level of achievement of students is still low in terms of their ability to think critically. This is because students are less accustomed to solving problems with a high level of ability.

The following shows one of the questions tested to students on Linear Program material.

1. Dewa and Dewi opened a flower shop. Dewa can complete 3 flower bags per hour and Dewi can complete 4 flower bags per hour. They work at least 16 hours a day, and the total number of bags made by both of them is at least 55 flower arrangements.
 - a. From the situation, what information is known and asked in the question?
 - b. Make a mathematical model of the story above.
 - c. Do you think the minimum working hours of Dewa and Dewi are the same or different? If their working hours are different, determine the minimum working hours for each of them.
 - d. What conclusion do you draw from the situation?

The questions above can measure critical thinking skills in indicators 1) Formulate problems into mathematical models, 2) Develop strategies and tactics, 3) Analyze arguments, and 4) Conclude. However, students are less able to answer these questions as in the table below.

Table 1.1 Student Work Result

Completion of Learner Worksheet	Description
 <p>a. Jam kerja atau produksi Dewi dan Dewa sebarang - sebarangnya 16 jam dan dapat menghasilkan paling sedikit 55 tangkai bunga. Dalam 1 jam Dewi dapat menyelesaikan tangkai bunga selukon Dewa hanya dapat menyelesaikan 3 tangkai bunga.</p>	<p>Based on the student's answer on the side, students do not understand the questions given, some students already understand what will be known and asked and rewrite it in the answer sheet.</p>
 <p>$3x + 4y \geq 55$ a. Dik = x = Dewa y = Dewi</p>	<p>Based on the student's answer on the side, students do not understand how to change the story problem into a mathematical model. Some students are still confused about making the \leq or \geq sign in the story problem. change the story problem into a mathematical model. Some students are still confused about making the \leq or \geq sign in the story problem.</p>
 <p>C. 1 $3x + 4y \geq 55$ $x + 7 \geq 16$ 3 $x + y \geq 16$ - $x \geq 16 - 7$ $3x + 4y \geq 55$ $x \geq 9$ $3x + 3y \geq 48$ - $y \geq 7$ $x \geq 9, y \geq 7$</p>	<p>Based on the student's answer on the side, in working on the two-variable linear inequality, the student did not change the \geq sign to $=$, although the answer was found, it became less precise.</p>

<p>D. Dewa dan Dewi bekerja berkurang" 16Jam Per hari tetapi Dewa hanya bisa merangkai bunga 3 dalam 1jam Sedangkan Dewi bisa merangkai bunga dalam 1 Jam jadi mereka harus lebih cepat Dewa harus lebihcepat kerjanya dari Dewi</p>	<p>Based on the student's answer on the side, in the process, the student can not concluded the known problem.</p>
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Based on the results of the analysis of the first question, the critical thinking ability of students is still lacking seen from the indicators, namely indicator 1) Formulate problems into mathematical models, 2) Develop strategies and tactics, 3) Analyze arguments, and 4) Conclude. Through these questions given to 30 students, it can be described that only 26.6% or 8 students seem to be able to understand and answer questions and 73.4% or 22 other students have not understood and answered the questions given. The need for time in developing critical thinking skills so that learning resources must be contemporary, interesting, provocative, entertaining, and rather short, such as songs, which will be relevant and compatible with critical thinking skills in solving problems (Saputri, et al., 2023:14).

One of the reasons for the low critical thinking skills of students is that teachers still apply teacher centered learning. Teacher Centered Learning is learning in the form of lectures when following the learning process or listening to lectures, students are only limited to understanding while taking notes. Paulo Freire, (2002:55) also criticized the "teacher centered program" education: He describes that in practice such an education system is more: (a) teachers teach, learners are taught; (b) teachers know everything, learners do not know anything; (c) teachers think, learners think; (d) teachers speak, learners listen quietly; (e) teachers impose discipline, learners are disciplined; (f) teachers choose and implement choices, learners only agree; (g) teachers do, learners only have the illusion of doing through the teacher's actions; (h) teachers choose program content, learners adjust; (i) teachers are subjects in teaching, learners are objects.

Paulo Freire's criticism above is expressed by (Shodiq, et al., 1999:77) by adding that this kind of education makes students passive, dare not say their

feelings, verbalism, mental illness, low self-esteem, uncritical, and unproductive. TCL (Teaching Centerd learning) which is centered on the teacher is no longer in accordance with the learning outcomes considering the development of increasingly sophisticated technology, it is expected that students can get knowledge not only from the teacher.

Looking at the situation in the field, namely based on the results of interviews with one of the mathematics teachers at SMAN 8 Medan, it is obtained that there are some students who get daily test scores below the KKM 70. This is because students have difficulty working on non-routine problems where the problems given during the test are different from the examples discussed during the lesson. Finally, students fixate on the solution given by the teacher and do not try to find other solutions. This also causes students' thinking skills in exploring information to be low, which also has an impact on conceptual understanding so that students cannot solve problems.

Students who have good problem solving skills will be able to face problems in their lives. Some other research results state the importance of critical thinking skills in solving math problems, such as Ambar, et al (2020) argue that students need to have critical thinking skills to solve math problems. In line with the results of Anggreini, et al research, namely, 27% of the level of students' critical thinking ability affects mathematical problem-solving ability.

In addition to the learning model which is a pedagogical anticipation, the design of the teaching materials used must also be clearly and systematically described in the presentation of material, sample questions are questions made based on indicators of critical thinking skills. Teachers have not implemented student worksheets that support students to develop critical thinking skills. Student worksheets often use student worksheets from publishers, whereas student worksheets can be made by educators themselves based on the needs of students so that they can build their concepts in solving problems. Therefore, learners tend to have the skills to remember and memorize concepts. On the other hand, there is a lack of maximum use of teaching materials in helping to deliver material and less varied in giving assignments.

In addition to the use of teaching materials, the use of learning media is also one of the factors that play an important role during the learning process. Teachers use media as an intermediary in delivering material so that it can be understood by students well. However, teachers do not apply media assistance in the learning process. The use of less innovative learning media makes students feel bored. Hamalik (in Arsyad, 2002: 15) suggests that the use of teaching media in the teaching and learning process can arouse new desires and interests, arouse motivation and stimulation of learning activities, and even have psychological effects on students. According to Siregar, et al., (2022: 62) an important role in media selection because it can present, edit and distribute information and the need to consider curriculum factors that can support the student learning process to achieve appropriate competencies. Therefore, the need for assistance from digital media to support the learning process of students. Digital media use in learning has become commonplace because it has adapted to the pandemic era (Amaluddin et.al (2022:27)).

In an effort to improve students' critical thinking skills and mathematics learning outcomes, it is necessary to innovate learning by paying attention to the suitability of models, methods and supporting media with the characteristics of the material presented so that learning objectives can be achieved as expected. One of the learning media that can be used is worksheets.

Learner worksheets (LKPD) include printed media from the development of print technology in the form of books, containing visual material including a summary of the material and exercises accompanied by questions to answer, a list of entries to complete and experimental sheets (Arsyad, 2006:6). Currently, student-centered learning is a trend in the world of learning and teaching. In learning, student worksheets is a very important media in student-centered learning because student worksheets is useful for guiding student learning activities. LKPD needs to be structured and interesting. Student worksheets can be prepared and adjusted to the situation and conditions of ongoing learning.

However, the problem faced at this time is that the quality of existing student worksheets is inadequate. This is caused by the mismatch between the existing

student worksheets and the needs of students. Most teachers use standardized worksheets purchased from printers as work materials during the learning process.

The results of interviews with Mrs. Sri Rahmawati, S.Pd, M.Pd, as a mathematics teacher at SMAN 8 Medan provided information that the student worksheets at school was not adequate for the needs of students. In addition, the ability of students to work on problems that are not the same as example problems will cause these students to have difficulty, this happens because of the lack of understanding of the concept of these students so that the ability to think is not maximized and the impact of reasoning skills is low. Most teachers use standard student worksheets from package books. The display in the student worksheets in the package book is less interesting and less interactive. In addition, the student worksheet has not been able to activate the critical thinking skills of students.

The student worksheet that is currently used does not present problems with adequate context, making it difficult for students to understand the material. The worksheets used is still general in nature, similar to those sold on the market, which are more likely to provide a summary of the material rather than involving students in learning activities. Therefore, the currently available student worksheets generally do not meet the criteria of validity, practicality, and effectiveness. As a solution, the existence of student worksheets can support the learning process and help students develop critical thinking skills in mathematics. So the teacher must be able to design creative learning that can invite students to think critically. Through interviews with teachers, information is obtained that students have difficulty with questions that require critical thinking skills.

Researchers analyzed several learning models that focus on students implemented into student worksheet, one of these models is Logan Avenue Problem Solving (LAPS)-Heuristic. Logan Avenue Problem Solving is a learning model that contains a series of questions in a guided problem solution. Logan Avenue Problem Solving (LAPS)-Heuristic learning model is a combination of problem solving learning with heuristic learning. Logan Avenue Problem Solving (LAPS)-Heuristic facilitates students in analyzing problems logically and quickly so that students' critical thinking skills can develop. This model is suitable for secondary school students who are still in the process of being guided to think critically.

The LAPS-Heuristic model can facilitate students to think critically as outlined in the student worksheets work. However, the availability of LKPD only comes from package books. Printed student worksheets has a weakness in the absence of audio-visual media. In addition, the material presented in printed form is still linear, unable to describe sequential events. In addition, making good printed student worksheets requires considerable costs. The commonly used printed version of student worksheets printed by publishers and usually only focuses on questions and answers to questions, without an explanation of how the answers to these questions are found. In addition, worksheets in printed form cannot be changed as needed at any time (Utami, 2020:22).

Based on these challenges, to overcome the shortcomings and weaknesses of printed worksheets, it is necessary to develop student digital worksheets that are able to present material through audio-visual media, can be changed as needed, and are more economical. According to Jenanda (2021:8), there are advantages in using student digital worksheets, namely: 1) minimizing time and space; (2) more environmentally friendly; (3) minimize expenses; (4) can be continuously upgraded because it is digital. Referring to these problems, researchers tried to design an interesting student digital worksheet that can be used both in offline and online learning. Therefore, through the development of student digital worksheets can support the quality of learning.

In the process of making student digital worksheets with the help of the Articulate Storyline 3 application, educators can use this application for free through the services provided by the Google search engine. Websites can create interesting mathematics teaching methods and make students have an interest in learning modern mathematics (Tambunan,et al.,2022:321). According to Yasin et al.,(2017:17), one of the interactive media that can be used is Articulate Storyline, because this software is very interesting if used as an interactive learning media. And this software can involve students in learning so that students can be active and make learning easier for students to understand (Siregar,et al.,2022:144)

According to Yumini & Rakhmawati (2015) stated that using interactive learning media based on Articulate Storyline can be used as a learning media in the classroom as well as learning media for students themselves independently. This

can be seen based on the results of the study which stated that the results obtained from validators with an average of 87.2% with very feasible criteria for use and the results of student responses using Articulate Storyline in classroom learning also responded back and were more interested in participating in learning.

Rafiana, et al (2018) stated that the use of interactive media based on Articulate Storyline can facilitate the learning process, and can grow the innovativeness and creativity of students in designing interactive and communicative learning and as one of the solutions that can be used as a way of solving problems amid the busyness of teachers today. And this Articulate Storyline-based media can also be a solution in improving the quality of learning, and an alternative. Limited opportunities for the teaching process carried out by the teacher.

By providing student digital worksheets based on Logan Avenue Problem Solving (LAPS)-Heuristics not only provides quality teaching materials but also provides answers to produce learning that is easy to understand. In addition, this student digital worksheet can facilitate the improvement of students' critical thinking skills by using a learning approach that is self-adjusting in the learning process. Based on the description above, researchers are interested in conducting a research entitled **"The Development of Student Digital Worksheets Based on Logan Avenue Problem Solving (LAPS)-Heuristic to Improve Critical Thinking Skills"**.

1.2 Identification of The Problem

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

1. Students' mathematical critical thinking skills are still low
2. The learning model is still teacher centered so that students do not actively participate during the learning process.
3. Teaching materials at school do not facilitate students' mathematical critical thinking skills.
4. The problems given in learning are routine problems and similar to the example problems given so they do not support the development of students' critical thinking.

5. Teachers have not used student digital worksheets that facilitate students' critical thinking skills.
6. During the mathematics learning process, teachers only use textbooks and teachers have not used student digital worksheets that can train students' critical thinking skills.

1.3 Scope of The Problem

This scope of this research is as follows:

1. The learning materials that will be developed in this study are Student Digital Worksheet using Articulate Storyline 3 based on the Logan Avenue Problem Solving (LAPS)-Heuristic model.
2. Indicators of mathematical critical thinking skills used in problem exercises on Student Digital Worksheet are: are 1) Interpreting, 2) Analyzing, 3) Evaluating, and 4) Concluding.
3. The material that will be used in the Student Digital Worksheet is an application of derivative class XI SMA Negeri 8 Medan.
4. Product implementation is only limited to expert validity tests and student responses.

1.4 Problem Limitation

The problem formulations in the study are to

1. The learning model used in this research is Logan Avenue Problem Solving (LAPS)-Heuristic model.
2. The research subjects were students of class XI IPA SMA Negeri 8 Medan.

1.5 Formulation of The Problem

Based on the problem limitations above, the problem formulations in the study are to:

1. How is the validity of Student Digital Worksheets in learning developed by using the Logan Avenue Problem Solving (LAPS) - Heuristic model on the topic of application derivative at class XI SMAN 8 Medan?
2. How is the Student Digital Worksheets' practicality in learning developed using the Logan Avenue Problem Solving (LAPS) - Heuristic model on the topic of application derivative at class XI SMAN 8 Medan?

3. How is the effectiveness of Student Digital Worksheets in learning developed by using the Logan Avenue Problem Solving (LAPS) - Heuristic model on the topic of application of derivative at class XI SMAN 8 Medan?
4. How is the student's answer process in solving problems related to students' mathematical critical thinking skills using the LAPS-HEURISTICS model student digital worksheets?

1.6 The Purpose of The Research

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

1. To obtain the validity of the Student Digital Worksheet using the Logan Avenue Problem Solving (LAPS) - Heuristic model using Liveworksheets based on the results of expert validation as an alternative teaching material to facilitate students' mathematical critical thinking skills on the topic of application derivative at class XI SMAN 8 Medan.
2. To obtain the practicality of the Student Digital Worksheet using the Logan Avenue Problem Solving (LAPS) - Heuristic model using Liveworksheets based on the results of expert validation as an alternative teaching material to facilitate students' mathematical critical thinking skills on the topic of application derivative at class XI SMAN 8 Medan.
3. To obtain the effectiveness of the Student Digital Worksheet using the Logan Avenue Problem Solving (LAPS) - Heuristic model using Liveworksheets based on the results of expert validation as an alternative teaching material to facilitate students' mathematical critical thinking skills on the topic of application derivative at class XI SMAN 8 Medan.
4. To find out the students' answer process in solving the test students' mathematical critical thinking skills using the LAPS-HEURISTICS model student digital worksheets.

1.7 The Benefits of Research

The results of this study are expected to have the following benefits:

1. For Student

It Can help students to improve critical thinking skills so that they can understand learning and apply it in their lives.

2. For Teachers

It Can add teacher input in applying different learning strategies and models to improve students' critical thinking skills.

3. For Researchers

It can add insight to researchers in making Student Digital Worksheet using valid, practical, and effective learning models.