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PROFILE OF STUDENTS' PROBLEM SOLVING ABILITY IN SOLVING CONTEXTUAL PROBLEMS VIEWED FROM PRODUCTIVE STRUGGLE

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Abstract. Problem solving ability is the ability that allows students to use understanding and facts to solve math problems. Productive struggle is the attitude shown by students when overcoming the difficulties they experience. This study aims to investigate and analyze problem solving ability based on students' productive struggle in solving contextual problems. The research method used is a qualitative approach with data collection techniques through problem solving ability tests, questionnaires regarding productive struggle, and interviews. The research subjects consisted of VIII grade students in several junior high schools. Data analysis was conducted by detailing test results, examining questionnaire responses, and analyzing interviews. The subjects were collected and selected based on the categories of high, medium and low productive struggle. This shows that the problem-solving ability of subjects with high productive struggle is very good, while subjects with medium and low struggle have not shown good things in problem solving ability. This is due to how to overcome the difficulties experienced by students.

Keywords**:** Problem Solving Ability, Productive Struggle, Contextual Problems

I. INTRODUCTION

Students' ability to solve problems remains important in the context of education because it is the basis for finding solutions to problems in order to achieve certain goals. Problem solving is a process in terms of understanding the problem to plan and implement the solution (Schoenfeld, 2016). Students' problem-solving ability in an educational context involve their ability to address problems by gathering facts and understanding mathematical concepts (Sumartini,2016; Kurniawati, 2019; Azhar, 2021). In addition, problem solving ability is the main goal in learning mathematics which requires individuals to think systematically, logically, critically and not give up until they find a solution to a problem (Dahar, 2011; NCTM, 2000; Anggraeni, 2020; Irawan, 2016; Afri, 2018).

The importance of problem-solving ability is owned by students because it is one of the foundations of various other mathematical abilities. Branca (1980) mentions the importance of problem-solving ability owned by students, namely the general purpose of teaching mathematics, problem solving which includes methods, procedures and strategies is a core process in the mathematics curriculum, and is a basic ability in learning mathematics. In addition, through problem solving ability students can identify the adequacy of data, make a mathematical model of a problem, select and apply strategies to solve problems, explain a result and apply mathematics meaningfully (Sumarmo, 20120).

Despite the crucial role of problem-solving ability, there are still relatively few students who excel in this area. Studies show that many students have low problem-solving ability, and these challenges can be traced back to various factors, including their initial abilities (Nisa, 2023; Suryani, 2020), learning style (Winarti, 2017; Sundayana, 2016; Syaputra, 2022), and fighting power (Arifin, 2020; Elentriana, 2017). Low problem-solving ability because students rarely face questions in the form of problems. The use of contextual problems in learning can make the material more relevant to everyday life. Contextual problems are problems that are in accordance with the situations experienced by students, in accordance with real life and close to students. (Rizki, 2018).

Stoltz & Pul (1997) Struggle power is the skill of someone who survives when experiencing difficulties and perseveres to get the desired goal. Math learning difficulties can be a challenge for students, but with strong fighting power students can overcome these difficulties and gain skills in the field of mathematics (Supardi, 2015). The drive that moves students toward understanding, reasoning and understanding mathematics is the definition of productive struggle (Warshauer, 2015).

Knowing students' productive struggle can provide an insight into how aspects of teaching can support and benefit students' understanding of mathematics in a natural classroom environment. (Hiebert et al., 2007; Kilpatrick, 2001; Mefiana & Herman, 2023). Several studies of productive struggle have found that students who engage in struggle when doing math have achieved higher levels of performance and made important gains in their math assessments (Hiebert & Wearne, 1993; Kapur, 2016; Rahmi, 2021; Stein et al., 1996; Wulandari, 2019). Therefore, it is important to know how students' problem-solving abilities are in solving contextual problems based on the productive struggles they have.

II. Methods

Descriptive qualitative is the method in this research. Three public junior high schools in Bandung City served as research sites, which were conducted in the odd semester of 2023/2024. Eighth grade students totaling 93 were the subjects of this study. **The spesific aims to describe students' problem-solving ability based on students' productive struggle**. Student participants in this study were students who had studied the area and perimeter of quadrilaterals, number operations and comparisons. At the initial stage, students were grouped into three groups with categories of high productive struggle power, medium productive struggle and low productive struggle. Then participants were given questions containing contextual problems to find out the problem-solving ability of each group. Then the results of student answers will be analyzed based on problem solving indicators.

The research outlined four principles: credibility, transferability, dependability, and confirmability (Yin, 2015). The principle of credibility ensures that the research accurately gathers and interprets data, guaranteeing that the findings and conclusions genuinely reflect and represent the subject of the study. The second principle, transferability, acknowledges that local conditions are unique and may limit the extent to which research findings can be generalized to other contexts (Lincoln & Guba, 1985).

Thirdly, dependability refers to the reliability and trustworthiness of the research. To ensure this, the researcher must provide a thorough summary of the entire research process, including detailed records of field activities. The final principle, confirmability, requires that research results and processes be verifiable for accuracy. To meet this standard, the researcher conducts observations and in-depth interviews with the subjects.

Indicators of problem-solving ability used in this study are understanding the problem, developing a solution strategy, planning and checking back. The scoring rubric used to analyze the problem-solving ability test is adapted based on Pebrianti's research (2023) as follows:

TABLE I
PROBEM-SOLVING ABILITY SCORE

Aspects assessed	Score	Description
Understand the problem	0	Misinterpreted/wrong at all (did not mention what is known and what is asked from the problem)
	1	Misinterpreted part of the problem, ignoring the conditions of the problem. (Mentioned/wrote what is known and what is asked from the problem inaccurately)
	2	Understands the problem completely. (Mentioned/wrote what is known and what is asked from the problem correctly)
Make a problem-solving plan	0	No plan, makes an irrelevant plan (Does not present a sequence of solution steps at all)
	1	Makes a solution plan that cannot be implemented, so the plan is impossible to implement. (Presents an impossible sequence of solution steps)
	2	Makes a plan correctly but is wrong in the result/no result. (Presents a correct sequence of solution steps but leads to the wrong answer)
	3	Makes a correct but incomplete plan (Presents a correct but incomplete sequence of solution steps)
	4	Make a plan according to the procedure and lead to the correct solution. (Presents the correct sequence of solution steps but leads to the correct answer)
Performing the plan/calculation	0	Does not perform calculations.
	1	Carries out the correct procedure and may produce the correct answer but miscalculates.
	2	Performs the correct process and gets the correct result
Rechecking results	0	No check or no other information
	1	There is an examination but it is incomplete
	2	Check is carried out to see the correctness of the process

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The problem-solving ability test, productive resilience questionnaire and interview are the data collection instruments in this study. To check the validity of the data, method triangulation was used (Sugiyono, 2013). The results of student answers and interviews will be considered valid if they correspond to each other and vice versa. Data collection in this study used several steps, namely (1) grouping students based on the results of the students' productive struggle questionnaire; (2) giving a problem-solving ability test in the form of a description question with the material of the area and perimeter of the rectangle, number operations and comparisons; (3) interviews conducted with students representing each category to conduct a deeper analysis of students' experiences when completing problem-solving-based questions.

The format of the problem-solving ability test given in this study is a form of description in order to examine the flow of student thinking based on the answers given. The questions given to students are the results of validation by mathematics education experts on content, construct and face validity. Then, by drawing conclusions and verifying information, data is obtained which will become new finding information regarding students' problem-solving abilities in terms of productive struggle.

Some limitations of this study are that the test materials and levels studied only apply to eighth grade students in junior high schools.

III. Results and Discussion

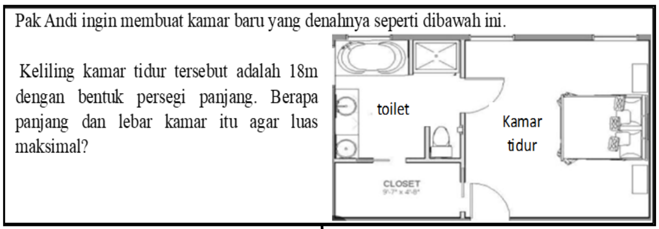
In eighth grade, students have studied the area and perimeter of quadrilaterals, number operations and comparisons. The results of students' productive struggle can be grouped as follows

TABLE III
RESULTS OF THE STUDENTS' PRODUCTIVE STRUGGLE QUESTIONNAIRE

Category	Number of Students	Percentage
Low	9	10
Medium	68	73
High	16	17

The table shows that the majority of students have moderate productive struggle power with 78% of all participants, which means 68 participants out of 93 students have moderate productive struggle. Then students with high productive struggle power have the least number of participants, namely 10% of all participants, which means that 10 participants out of 93 students have high productive struggle. Furthermore, each category is taken one subject to conduct an interview that will show the subject's problem-solving ability

The results of the problem-solving ability test and student interviews are the data of this study. Test data and student interviews about students' problem-solving abilities will be categorized based on high productive struggle (DT), medium productive struggle (DS) and low productive struggle (DR). The following will describe the results of student answers to solving problem number 1 from each category.



The following is the form of problems on the area and perimeter of rectangles with contextual problems based on problem solving:

1.Mr. Andi wants to build a new bedroom with the floor plan shown below.
The perimeter of the bedroom is 18m with a rectangular shape. What is the length and width of the room for maximum area?

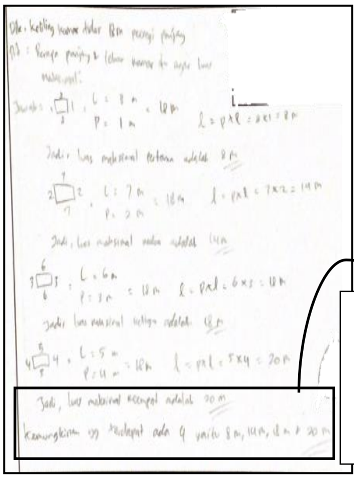
Fig.1 test questions of problem solving ability

The following are some of the participants' answers to question number 1:

1) *Subjects with High Productive Struggle Category (DT)*

The results of the answers made by subjects with high struggle (DT) in question number 1 are quite good. Subject DT was able to write down all the possibilities to compare the maximum area of the room. For the other problems, subject DT was able to answer the problems well from the 5 problems given. In addition, the DT subject was able to write down the things known and asked to answer the question, which means that the DT subject understood the problem well. The following is the result of subject DT's answer to problem number 1 shown in Figure 2

Fig.2 DT subject's answer to question number 1



So, the fourth maximum area is 20m.
There are 4 possibilities which are 8m, 14m, 18m, & 20m.

In the drawing given, subject DT seemed to understand the problem well even though in the conclusion the subject wrote the results of all the possibilities found to ensure that the researcher conducted an interview. The following is an excerpt of the interview conducted by the researcher (P) with the DT subject regarding this question.

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P : So what is the conclusion of the largest area?
DT : There are four ma'am
P : What does maximum mean?
DT : The biggest one means the 20 m one.
P : What is the length and width?
DT : The length is 5 and the width is 4 ma'am.

The results of the interview quotation conducted by DT subject were able to provide answers well. At the stage of making a problem-solving plan, DT subject was able to make a plan correctly even though the writing was incomplete. When doing the calculation plan, subject DT did not make mistakes, meaning that he was able to do the process correctly and get the correct results. However, at the stage of checking back the DT subject did not seem to do it. The thing that subjects with high solving ability did not do was to reexamine the answers found (Pebranti, 2023).

In addition, the DT subject admitted that he initially had difficulty working on this because the DT subject was confused by the problem given. that is because the problem given has no information other than circumference. However, subject DT did not give up and tried to deal with his difficulties by re-reading the problems given, this shows the productive fighting power of students in facing difficulties in solving contextual problems.

2) Subjects with Moderate Productive Struggle Power Category (DS)

Subjects with moderate productive struggle (DS) did not write down the known and questionable information in the problem. Subject DS was less able to understand the problem so that when interpreting the problem given by the DS subject experienced errors. It can be seen in Figure 3 that subject DS only wrote down one possibility. When confirmed, subject DS said he did not read the problem properly so that the 'maximum' information was missed which resulted in subject DS only writing down one possibility.

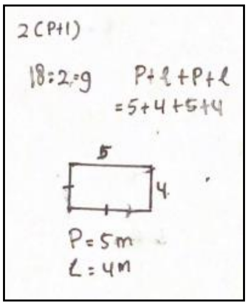

Fig.3 DS subject's answer to question number 1

At the planning stage of making a problem-solving plan, subject DS did not write correctly even though it was not systematic but produced the correct answer. Subject DS made a mistake because he did not read 'maximum area' so he did not look for the area value that could determine the answer. The following is an interview excerpt regarding question number 1.

P : Are there any other possibilities?
DT : No ma'am.
P : What does maximum mean?
DT : Maximum from where mom
P : Why don't you read the problem again?
DT : Oh yes, ma'am, I didn't read it.

When doing the calculation plan, subject DS did not make mistakes so that the results obtained were correct. When subject DS was asked to look for other possibilities, subject DS was able to answer with a few help questions. In addition, the productive fighting power seen by subject DS was able to answer after being given a question that stimulated the subject to answer. At the stage of checking the results again the subject did not do so that some aspects of relational understanding ability that were not carried out correctly were at the stages of making a problem-solving plan and checking again.

3) Subjects with Low Productive Struggle Category (DR)

When understanding the problem given, subject DR was unable to write down the information understood correctly as a result subject DR made mistakes when answering the problem. Subject DR did not seem to understand the meaning of the word 'circumference' so he was unable to know the information that could be used to answer the problem. The following are the results of the DR subject's answers to question number 1

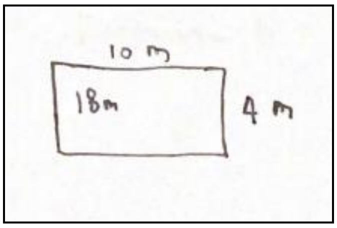

Fig.4 DR subject's answer to question number 1

Furthermore, the planning stage of the DR subject did not write the plan properly and produced an incorrect answer. The same thing DR subject did when doing the calculation, DR subject did not calculate the circumference correctly. Knowledge related to the circumference used by the subject DR does not have this information. In the difficulties experienced, the DR subject did not understand the problem well. the following is an excerpt of an interview conducted with the DR subject regarding the answer to question number 1.

P : Do you understand the problem given?
DT : No ma'am.
P : Do you know what circumference is?
DT : Plus the sides.
P : Then what did you write down?
DT : The top is 10, the right-left edge is 4, so 18 ma'am.

In terms of productive struggle, subject DR does not seem to do anything that can help in dealing with difficulties. subject DR seems to show a 'resigned' attitude in working on the problems given. In addition, the DR subject's knowledge related to the material tested was erroneous so that the DR subject was unable to answer well all the questions given. In the other four problems, subject DR was unable to answer correctly. Subject DR wrote answers with errors when doing calculations (in question number 3) and errors when understanding the problem (in questions number 2, 4 and 5). This shows that subject DR is unable to fulfill all indicators of problem-solving ability. Students with low problem-solving ability have not been able to understand the problem and plan problem solving (Rizki, 2018).

Problem solving ability is one of the abilities that students must have. In fact, students' problem-solving ability are relatively low. This can be seen from the results of the analysis of this study which shows that students have not been able to fulfill all the indicators of problem-solving ability given In addition, it is evident from the fact that only a few students are able to fulfill aspects of problem solving ability on each problem.

In addition, based on the findings in this study, subjects with high productive struggle appear to have good problem-solving ability. This is because high productive struggle helps students in overcoming the difficulties faced and tends to struggle to find other ways when facing difficulties. In addition, subjects with moderate productive struggle were seen to often make mistakes when planning and performing calculations. In subjects with low productive struggle, problem solving ability is not visible because they are unable to understand the problem correctly so they make many mistakes. However, none of the three subjects were able to fulfill the indicators of problem-solving ability at the stage of re-examining the answers found.

In accordance with research conducted by Warshauer (2015) which says that the role of students' productive struggle can support students doing math which has implications for student learning with understanding. Students who have high productive struggle have a more motivated attitude and try hard to give the best results. Furthermore, research conducted by Rahmi (2021) states that if teachers can use students' productive struggle to overcome the difficulties they experience, it can have an impact on student learning outcomes. This research helps explain the importance of students' productive fighting power. Students with high productive struggle also have good mathematical understanding

IV. Conclusions

The conclusion that can be obtained in this study is that students with high productive struggle are able to achieve problem solving ability well while students with moderate productive struggle power are able to fulfill the indicators of understanding and designing plans with errors. Students with low productive struggle were not able to fulfill all indicators of problem-solving ability. One of the factors for this is the way they overcome their difficulties so that subjects with moderate and low productive struggle tend to surrender when faced with difficulties when working on these problems.

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