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Analyzing Students' Adversity Quotient to See Students' Deductive Reasoning Capabilities in Solving Mathematical Problems on Linear Program Materials

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Abstract: The purpose of this study is to examine and characterize students' use of deductive reasoning when addressing mathematical problems using linear programming that is based on the Adversity Quotient. This kind of study is qualitative and descriptive. Purposive sampling was the method of sampling employed in this study. There were three different sorts of pupils in class XI IPA I SMA Negeri 5 Batanghari: Quitter, Camper, and Climber types. There were 19 total participants in the study. Each category was represented by one subject, resulting in three students who were chosen as research subjects. Questionnaires, interviews, and tests of problem-solving were the research instruments employed in this study. The processes of (1) Reducing the data, (2) Presenting the data, and (3) Concluding were used to evaluate the collected data. The research's findings demonstrate that Quitter-type kids are capable of performing calculations based on rules or formulas to comprehend difficulties. Still, they are unable to meet the problem-solving markers when it comes to formulating logical conclusions and gathering direct evidence. Students who are camper type can compute using rules or formulas to comprehend problems, plan, and carry out plans, but they are unable to double-check. Students cannot meet the issue-solving markers when they are gathering direct facts and generating logical conclusions. Students who are climber types can satisfy deductive reasoning requirements by comprehending problems, making plans, carrying them out, and double-checking.

Keywords: Adversity Quotient, Deductive Reasoning Ability, Solution to problem

A. Introduction

Learning mathematics is an endeavor to support pupils in developing mathematical ideas or principles according to their capacities through a process of interaction (Handayani, 2018). One of the main learning goals in the classroom is to highlight the students' capacity for communication, thinking, and problem-solving (Maulyda, 2019). The ability to solve problems is essential to learning mathematics since it relates to real-world issues and helps students become more analytical and critical decision-

makers in a variety of contexts (Amanda dkk., 2020). Additionally, problem-solving is a planned procedure that must be completed to arrive at a specific answer (Shodiqin dkk., 2020). Students must utilize reasoning when studying mathematics and resolving mathematical puzzles.

One of the objectives of learning mathematics is to master reasoning skills. This is consistent with the learning goals highlighted by the NCTM (National Council of Teachers of Mathematics), which are as follows: 1) gaining a knowledge of mathematics; 2) learning to reason in mathematics; 3) Acquiring communication skills (mathematics); 4) Acquiring the ability to connect concepts mathematically 5) Acquiring the ability to express them mathematically; 6) Acquiring problem-solving skills (specifically in mathematics) (NCTM, 2000). Mathematical reasoning is the capacity to reason within a mathematical framework. A set of cognitive processes known as mathematical reasoning are used to conclude by making connections between many known facts (Ervani et.al, 2019).

In general, there are two categories of mathematical reasoning: deductive reasoning and inductive reasoning. Making a deduction from a specific statement to a general assertion is known as inductive reasoning (Amir, 2014). In general, there are two categories of mathematical reasoning: deductive reasoning and inductive reasoning. Making a deduction from a specific statement to a general assertion is known as inductive reasoning (Sumarmo & Permana, 2013). The research will additionally involve over-deductive reasoning. When someone is faced with an issue, they will use deductive reasoning to solve it since problem-solving is an interrelated process. Problem-solving is a thought process that begins with comprehending the issue, followed by conclusions about how to address it and a review of previously proposed solutions (Polya, 1973).

Among the signs of the capacity for deductive reasoning are: 1) The ability to perform computations using specific guidelines or equations 2) Coming to rational conclusions 3) Gathering concrete evidence 4) Gathering oblique evidence 5) Using mathematical induction to compile proofs (Sumarmo & Permana, 2013). As for the indicators for problem-solving that students need to meet, Polya (Septian et al., 2022; Widodo et al., 2018) states that they are as follows: 1) Recognizing the issue; 2) Formulating a plan of action 3) Executing the strategy 4) Verifying once more.

When it comes to problem resolution, AQ (Adversity Quotient) intelligence is employed. A person's aptitude or intelligence is measured by their capacity to withstand adversity and find solutions to it (Stoltz, 2007). Pupils with high AQs are undoubtedly more equipped to get past their challenges when it comes to problem-solving. On the other hand, children with lower AQ levels often see challenges in problem-solving at the end of the fight, which lowers their enthusiasm for achievement. It appears that issues with students' ability to fight back are the primary issue. Students' lack of fighting spirit serves as an example of their poor problem-

solving skills. Not only does this hinder academic advancement, but it also negatively affects the kids. Students' limited capacity to solve difficulties also results in decreased motivation to continue excelling (Diana, 2018).

According to (Indah & Nuraeni, 2021), problem-based learning resources like problem-based questions can help students become more proficient in deductive reasoning. Linear programming is a problem-based subject that can help pupils develop their logical reasoning skills.

Based on preliminary observations, the field's reality is that students' reasoning skills for solving mathematical issues remain low when they are studying, particularly when it comes to linear programming curricula. Errors and trouble grasping the provided problem arise from a lack of thinking proficiency. This came from an exam that was administered by researchers using linear programming problems to students in class XI Science I SMA Negeri 5 Batanghari. According to the results, as shown in Figure 1 below, the average student still struggles to meet the assessed indicators.

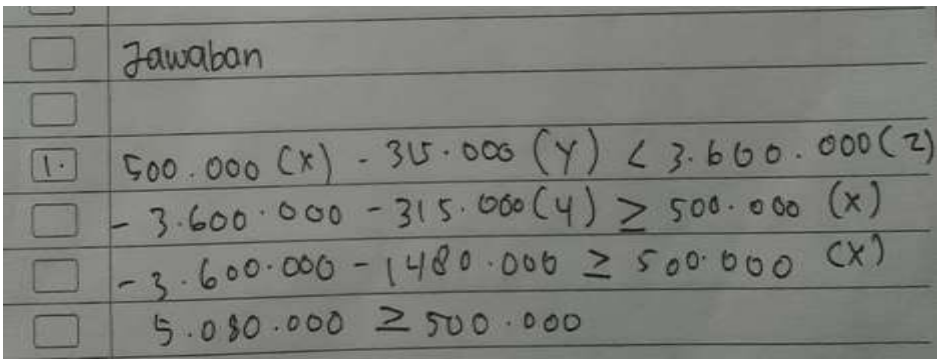

Figure 1. Student Work Results Showing Signs of Deductive Reasoning

Students are encouraged to use reasoning, problem-solving skills, and mathematical principles to answer the offered questions. In actuality, though, too-long story questions confuse pupils and make it challenging for them to solve the problem. Although most students have made an effort to answer question number one accurately and thoroughly, they typically are unable to do so using deductive reasoning indications. Thus, the researcher carried out a study titled "Analysis of Students' Deductive Reasoning Ability in Solving Mathematical Problems on Linear Program Materials Seen from Adversity Quotient in High School Students" based on the background information mentioned above.

B. Methods

This study is qualitative and descriptive. Nineteen students from class XI IPA I SMA Negeri 5 Batanghari made up the study's population. Class Good was employed in this study. Purposive sampling is the method used to choose study participants. Test

questions, interview sheets, and questionnaires are the different kinds of instruments employed in this study. The forty-item questionnaire is used to classify students into Adversity Quotitent categories. There is just one description question in the test questions. Predetermined indications are included in the linear programming material that is delivered. The interview sheet questions align with logical thinking and problem-solving skills indicators. The analysis was done in phases. Firstly, the students' work was used as the research subject, and the results of the interviews were then simplified. Students were then divided into Quitter, Camper, and Climber types using questionnaires and math test questions that required problem-solving. The data is examined and presented descriptively in the second step of the data presentation process. Making inferences from the data collected and the analysis's findings constitutes the third step. The indicators and descriptors of deductive reasoning used in this research can be seen in table 1 below.

Table 1. Deductive Reasoning Indicators and Descriptors

Indicator	Descriptor
Carry out calculations based on certain rules or formulas	a. Students are able to recognize mathematical ideas and procedures in given scenarios or issues. b. Students can carry out mathematical engineering processes, to make calculations easier c. Students are able to create mathematical models of assertions and problems that need to be verified. d. Students are able to describe how to remedy the issue.
Making sense-based decisions (logical reasoning)	a. Students can provide reinforcement for a statement that is already known to be true b. Students are able to make inferences from the completed tasks, and these inferences serve as
Assemble concrete proof	a. Students can look into the veracity of an established claim. b. Students are able to fix completion mistakes

(Source: Sumarmo & Permana, 2013)

C. Results and Discussion

The 19 students were split into three groups after the researchers administered a questionnaire to classify them into Adversity Quotient types: 3 Quitter-type students, 8 Camper-type students, and 8 Camper-type kids. Next, using one sample of each type, the researcher administered a test to a subset of SMA Negeri 5 Batanghari's class XI Science students. Each subject was described with one question. As a result, the author developed indicators that, when applied to the difficulties presented in the provided Linear Program questions, can serve as a benchmark and analytical guide. The indicators are arranged according to AQ type, deductive reasoning skill, and problem-solving. This facilitates the author's ability to draw inferences on the handling of the collected data. The following conclusions about the three subjects' deductive reasoning skills in solving linear programming problems were drawn from the research findings.

Table 2. Results of Students' Deductive Reasoning Ability in Problem Solving

Subject	Indicators of Deductive Reasoning Ability	Solution to problem			
		Recognizing the Issue	Planning a Solution	Implementing the Plan	Verify once more
S1	Make computations using certain guidelines or formulas	✓	-	-	-
	Draw Logical Conclusions	-	-	-	-
	Constructing Direct Evidence	-	-	-	-
S2	Make computations using formulae or rules	✓	✓	✓	-
	Draw Logical Conclusions	-	-	-	-
	Constructing Direct Evidence	-	-	-	-
S3	Make computations using certain guidelines or formulas	✓	✓	✓	✓
	Draw Logical Conclusions	✓	✓	✓	✓
	Constructing Direct Evidence	✓	✓	✓	✓

The results of the student tests on the three linear program material subjects are summarized in Table 1, along with recommendations for evaluating the deductive reasoning and problem-solving skills of the class XI Science students at SMA Negeri 5 Batanghari. In the case of subject 1, Quitter type (S1) only satisfies the deductive reasoning ability indications while performing calculations based on rules or formulas and comprehending the situation. When it comes to comprehending difficulties, formulating solutions, and carrying out plans, Subject 2 type Camper (S2) satisfies the markers of deductive reasoning ability. In addition, subject 3 type Climber (S3) satisfies every criterion for the capacity for deductive reasoning in mathematical problem-solving.

Sumarmo (2013) states that the following criteria were chosen as a benchmark in this study: 1) Ability to perform calculations based on specific rules or formulae; 2) Ability to draw logical conclusions; and 3) Ability to gather firsthand evidence. According to Polya's perspective (Septian et al., 2022; Widodo et al., 2018), the following are indicators for solving mathematical problems: 1) Understanding the problem 2) Planning the solution 3) Executing the strategy 4) Verifying once more. Students must be able to recognize processes and concepts, perform mathematical engineering, and draw conclusions from the final results in the first deductive reasoning indicator. In

the second, students must be able to reinforce prior knowledge and draw conclusions, and in the third, they must be able to look into and fix completion errors. It is envisaged that students would be able to solve problems by using each deductive reasoning indication, which includes: 1) Understanding the problem; and 2) Planning a solution. 3) Executing the strategy 4) Verifying once more.

Based on a recapitulation of research data, analysis reveals that students at SMA Negeri 5 Batanghari, particularly in class, have a deductive reasoning skill while solving mathematical issues. An examination of the responses provided by the students to the specified problem-solving questions is presented below.

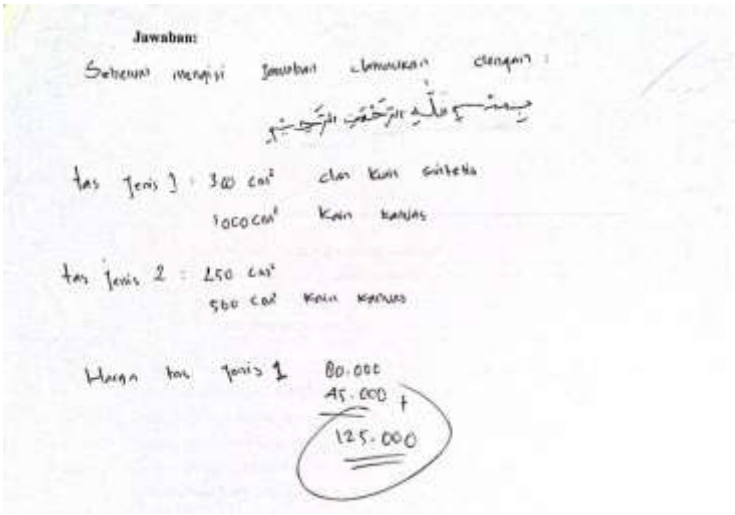

Figure 2. Sample of Quitter Type Student Work

The results of the first student's work, specifically that of Quitter-type students who are classified as still lacking deductive reasoning abilities in problem-solving, demonstrate this. These students are only able to write down what they know from the problem and are unable to move on to the next step. This is evident in the first sample that the researcher took. Consequently, it might be concluded that the student was not able to resolve the issues raised by the questions. This is consistent with earlier research by Baharullah et al., (2022), which found that pupils in the quitter category are merely able to comprehend mathematics problems rather than solve them. These pupils are therefore classified as having low deductive reasoning skills when it comes to problem solving. According to the student's interview results, it was discovered that the student had trouble understanding the concept of the Linear Program material and could only write down what they knew from the questions. This prevented the students from moving on to the next stage of the work and caused them to encounter difficulties. It may be argued that they are not capable of solving problems using logical reasoning.

Figure 3. Sample of Camper Type Student Work

The second sample consists of the work of students who fit the Camper type and are considered to have reasonable problem-solving skills in deductive reasoning. When understanding the problem, the student in the indication performs calculations based on rules or formulae. The ability to construct mathematical models and functions that fit the problem in the problem demonstrates the student's understanding of the problem in the problem. The student's ability to carry out calculations based on rules or formulas to plan the answer is then demonstrated by their ability to complete the elimination and substitution process.

The learner is then able to solve the problem in the indicator of carrying out calculations based on rules or formulae in carrying out the plan, however there are faults that cause the results achieved to be incorrect. This is a result of the student's inability to evaluate the procedure and outcomes. This is consistent with research by Hofifah et al., (2023), which found that camper subjects could complete three phases of problem solving: 1) comprehension of the problem; 2) planning the solution; and 3) execution of the plan. Rechecking for the fourth stage, the camper subject was still unable to complete this step.

Figure 4. Sample of Climber Type Student Work

The third sample contains work completed by students that fit the Climber type, who are thought to have strong deductive reasoning abilities when it comes to problem-solving. When a student in the indication performs calculations using formulae or rules, comes to logical conclusions, and presents concrete evidence to demonstrate their grasp of the issue. The ability to construct mathematical models and functions that are appropriate for the problem in the problem demonstrates the student's understanding of the problem in the problem. The student can then be shown to be capable of performing calculations based on rules or formulae, deriving logical conclusions, and gathering concrete evidence when devising a solution by correctly performing the process of variable substitution and elimination.

The student is then able to answer problems correctly by the problems contained in the questions using the appropriate methods and results when it comes to the indicators of performing calculations based on rules or formulas, drawing logical conclusions, and assembling primary evidence in carrying out the plan. The student is then able to re-examine the entire process and results in the indicator, performing calculations based on rules or formulas, deriving logical conclusions, and gathering direct evidence to obtain the correct results by the question. According to research by Aini & Mukhlis (2020), climber-type students are capable of meeting all the requirements for problem-solving in story problems, including those for

comprehending the problem, formulating a strategy for solving it, carrying out the plan, and reviewing the answers.

Students who are quitters do not respond to problems with good enthusiasm, according to research findings regarding the Adversity Quotient. This is a result of the quitter type of student's inability to persevere through hardships, which causes them to quickly give up and cease their efforts to find solutions. When answering questions, kids who fit the camper type demonstrated a fair amount of enthusiasm. Their efforts are restricted to following the plan for solving the problem; they do not verify the solutions they receive. When it comes to answering problems, pupils who possess the climber type exhibit good passion, persevere through difficulties, and never give up. This supports the theory put forth Stoltz (2007) that the climber type always makes an effort to achieve the best results while taking into account the challenges that are already present, the camper type is easily satisfied with what they encounter, and the quitter type tends to avoid situations or difficulties that they feel uncomfortable with desire to improve. A linear program served as the research's material. The mathematical content of linear programming materials is organized as follows.

Table 2. Mathematical Content Organization

	Programming in Lines
Reality	Objective functions, constraint functions, graphs, intersection points, and solution areas in mathematical modeling
Draft	Function Goal Constraint Fucntion Graph Cutting Point Settlement area
Skills	Determining the optimal value of a linear programming problem
Principle	Finding a linear problem's optimal value can be done via linear programming. Using an objective function $f(x, y) = ax + by$ where the line of inquiry is $ax + by = Z$

This research is supported by a number of earlier investigations. The first was titled "Analysis of Visual Thinking Ability in View from the Adversity Quotient" and was carried out at SMK Negeri 1 Sei Rempah by Wahyuni et al., (2022). More research is required to examine students' visual thinking processes because the purpose of this study is to characterize students' visual thinking abilities in terms of the Adversity Quotient. Descriptive qualitative research is the kind of study that this is. Students from Vocational High School (SMK) participated in this study. Quitter, Camper, and Climber were the three class X pupils who served as the research subjects. Tests, questionnaires, and interviews were the methods used in this study to gather data. The study's findings suggest that not all phases of visual thinking have been exhibited by Quitter level kids. The visual thinking stages are beginning to emerge at the Camper and Climber levels, although there are still challenges in the Imaging and Showing & Telling stages at both levels. According to the study's findings, employing

Geogebra-based learning resources is required to raise the Adversity Quotient and enhance visual thinking abilities.

Rahmi et al., (2021) "Analysis of Mathematical Problem-Solving Ability Based on Adversity Quotient (AQ) of High School Students" provided additional supporting evidence. The purpose of this study is to characterize students' aptitude for solving mathematical problems using the adversity quotient (AQ) in sequence and series content. This kind of study uses descriptive methodologies and is qualitative in nature. Purposive sampling was used to choose 20 students from class XI IPA I SMAN 5 Pekanbaru as the research subjects. The adversity quotient questionnaire, test questions for mathematical problem-solving skills, and interview protocols were the instruments employed in this study. The Miles and Huberman technique, which consists of three stages data reduction, data presentation, and conclusion drawing or verification is used in data analysis. The average percentage of the student group with a high adversity quotient was 75.69% in the good category, the average percentage of the student group with a medium adversity quotient was 66.66% in the fair category, and the average percentage of the student group with a low adversity quotient was 55.21% in the poor category, according to the results. In this study, issue solving is explained in terms of the adversity quotient.

The paper "Analysis of Mathematical Critical Thinking Ability in View from the Adversity Quotient" was published in Baihaqi (2020), Department of Mathematics Education, Siliwangi University. The purpose of this study is to examine, in terms of the adversity quotient, pupils' challenges in answering test questions pertaining to mathematical critical thinking abilities. This study uses an exploratory descriptive research design and is qualitative in nature. In accordance with the researcher's preferences, the subject selection method takes a purposive approach by focusing on the attributes of the students. Students at MA Negeri 2 Tasikmalaya City's class X MIA 2 served as the research subjects. There were no Quitter type AQ subjects in this investigation. As a result, the study's subjects were one of each of the following: AQ kinds going from quitters to campers, campers to climbers, and climbers for each type. An Adversity Response Profile (ARP) questionnaire, a test of mathematical critical thinking skills, and think-aloud, unstructured interviews were the methods of data collecting employed in this study. The study's findings showed that: (1) Students with the AQ type who were quitting, becoming campers, becoming climbers, and becoming campers met all criteria for mathematical critical thinking ability. Type AQ shifting from quitters to campers and from campers to climbers produced results that were erroneous; however, kinds of campers and climbers received accurate results; (2) Students moving from quitters to campers have trouble applying concepts and linguistic difficulties when practicing mathematical critical thinking skills. Campers struggle to evaluate arguments and identify assumptions utilizing principles. The kind that moves from camping to climbing finds it challenging to apply ideas and guidelines. Climbers struggle to recognize assumptions utilizing principles. This

study's equation describes how to solve problems by applying the Adversity Quotient.

In addition, there is the study "Analysis of High School Students' Mathematical Reasoning Ability on Function Limit Material" by Limustafa & Awan (2019). Through the classification of high, medium, and low levels of mathematical reasoning ability, this qualitative descriptive study seeks to examine the degree of students' reasoning abilities in answering problems on function limit material. Twenty kids in class XII served as the research subjects. Giving four written test questions and conducting interviews with chosen respondents is the method used to collect data. The average score for all questions on the mathematical reasoning ability instrument, according to the analysis results of this study, was 89% for the indicator of performing calculations using applicable mathematical formulas or rules, 84% and 64% for the indicator of drawing conclusions, and 93% for the indicator of making estimates. in order for the average and total to equal 83%. Therefore, class XII high school students have rather strong mathematical reasoning ability. This research and Limustafa & Awan's (2019). research both discuss reasoning abilities; however, this research differs in that the researcher employs deductive reasoning abilities instead of other types.

D. Conclusion

Based on the research conducted, it is possible to conclude the deductive reasoning skills of students at SMA Negeri 5 Batanghari, particularly in class XI Science, by examining the outcomes of instrument tests on the students' provided Linear Program material. Only using rules or formulas to grasp the problem, logical conclusion indications, and direct proof compilations—which only climber-type students can complete—are indicators that can be met by all types of AQ. On the other hand, if the Adversity Quotient is used as a basis, it can be concluded from research findings that students who are quitter types tend to avoid challenging situations and give up readily. The camper type is the one who finds things quickly and doesn't bother to double-check. The climber type is the one who never gives up on obstacles and is constantly striving for the best outcomes.

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