Students’ Relational Understanding in Quadrilateral Problem Solving Based on Adversity Quotient

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Abstract. The type of research is qualitative approach which aims to describe how students’ relational understanding of solving mathematic problem that was seen from Adversity Quotient aspect. Research subjects were three 7th grade students of Junior High School. They were taken by category of Adversity Quotient (AQ) such quitter, camper, and climber. Data collected based on problem solving and interview. The research result showed that (1) at the stage of understanding the problem, the subjects were able to state and write down what is known and asked, and able to mention the concepts associated with the quadrilateral problem. (2) The three subjects devise a plan by linking concepts relating to quadrilateral problems. (3) The three subjects were able to solve the problem. (4) The three subjects were able to look back the answers. The three subjects were able to understand the problem, devise a plan, carry out the plan and look back. However, the quitter and camper subjects have not been able to give a reason for the steps they have taken.

1. Introduction
Mathematics is one science that is needed in human life. In learning mathematics, students are trained to be critical, logical, systematic, and able to solve problems encountered in everyday life, so that math becomes important to be studied and applied in the learning process from elementary school level to higher school level. One of Mathematics’s material is quadrilateral. Quadrilateral is consist of square, rectangle, trapezoid, pararellogram, rhombus and kite. These planes were commonly found in our daily life.

In fact, there are many students have difficulty in studying quadrilateral at school. In addition, students also often make mistakes in determining methods and formulas when applying on quadrilateral. Therefore, the understanding of the concept of a quadrilateral is an important thing that must be mastered by students in learning mathematics.

The understanding of concepts in mathematics learning is very important. Types of understanding are classified into relational understanding and instrumental understandings [1]. Relational understanding is described as knowing both of what and why to do something, whereas instrumental understanding entail rules without reasons. Aspects of understanding that students need in the learning of mathematics is not just know the concept, but a deeper understanding called as a relational understanding. Relational understanding is the ability to deduce specific rules or procedures for more general mathematical relationships [2]. The relational understanding as ability to relate between conceptual knowledge and procedural abilities. Conceptual knowledge contains relationships between a mathematical concepts with other mathematical concepts, whereas procedural knowledge is a related...
knowledge of symbols to present mathematical ideas and rules in accomplishing mathematical tasks [3]. Relational understanding reached if student is able to link a concept with the other concept and understanding each step that used to solving a problem.

Problem solving is an attempt to find a way out of a difficulty in order to achieve goals that are not immediately achievable [4]. Through this activity, its important aspects of mathematical skills such as the application of rules to non-routine problem, pattern discoveries, generalization, mathematical communication etc. can be better developed. Problem solving as the means by which an individual uses previously acquired knowledge, skills and understanding to satisfy the demands of unfamiliar situation [5].

The stages of problem solving are understand the problem, devise a plan, carry out the plan, and look back [4]. In this study, researchers used the problem-solving steps will be examined how the relational understanding of students in solving problems.

**Table 1. Aspects of relational understanding**

| Polya’s Problem Solving Steps | Aspects of Relational Understanding |
|------------------------------|-------------------------------------|
| Understanding the problem    | How the subject declare or write down what is known and expressed using it |
| Devising a plan              | How the subject declare whatever concept is given in relation to the given problem and plan the a solution by linking the concept of the existing concept and the reasons |
| Carrying out the plan        | How the subject apply the procedure of mathematical relationships that have been planed for reasons |
| Looking back                 | How the subject check the truth of the answer by checking each steps |

In general, students will have difficulty in understanding mathematics problems. This is due to each student have different respond ability to solve difficulties of a problem that called Adversity Quotient (AQ). AQ is a measure of knowing one's response to adversity [6]. The categorization of AQ in solving problems are quitter (low AQ), camper (being AQ), and climber (high AQ).

Based on the background of research that has been explained, the purpose of this study is to describe the relational understanding of students with the category AQ quitter, camper and climber in quadrilateral problem solving.

2. Method
This research use qualitative approach that aims to describe how students’ relational understanding in quadrilateral problem solving based on Adversity Quotient (AQ). Research subjects were three 7th grade students of Junior High School. Research subject were taken by category of Adversity Quotient (AQ) such quitter, camper, and climber. The instruments of this research involves quadrilateral problem solving tasks used to describe relational understanding. Data collecting was conducted using interviews on the problem-solving task. Data analysis consist of three steps namely condensed data, presented data and conclusion data. The written and interview data are analyzed according to indicators of relational understanding on every problem solving steps.

3. Results and Discussion

3.1. Results
In this section, it was discussed the results of research based on the relational understanding of junior high school students in solving quadrilateral problems reviewed from their Adversity Quotient (AQ).
3.1.1. Relational Understanding Climber Subjects in Solving Quadrilateral Problems.

At the stage of understanding the problem, the subject writes and declares what is known to be important points in the problem, such as the length and width of the rectangle and their size, the area of both is the same. She is able to distinguish both quadrilateral and rectangular shapes by mentioning and drawing them on an answer sheet. She states and writes down what is asked in the given problem. She mentions concepts related to given problems, such as square, square area, rectangular area, and square circumference.

At the next stage, she plans the completion by linking the mentioned concepts, such as square side in variable \(x\), modeling the area of square and rectangle in variable \(x\), making equation of those two areas to obtain the value of \(x\), calculating the square circumference, and giving the reasons for each planned step as seen in figure 1.

![Figure 1. Example of students’ complete performance on the task](image)

At the last stage, she examines the answers obtained by recalculating the results of his work, looking back at the answers obtained, looking at the ways that have been done and matching the final answer to the questioned on the problem.

3.1.2. Relational Understanding of Camper Subjects in Solving Quadrilateral Problems.

At the stage of understanding the problem, she writes what is known only in the form of the points only. She states verbally what is known are the length and width of the rectangle along with its size, the area of both is the same, and distinguishes the form of both the building of the square and the rectangle. She mentions the concepts contained in the problem of quadrilateral, square, square area, rectangular area, and circumference of the square.

At the next stage, she plans the solving steps by connecting the mentioned concepts to the problem, such as equalizing the square with the length of the rectangle, finding the side of the square, calculating the circumference of the square. Subjects are not able to give a reason on every step planned.
At the problem solving stage, she searched for the square side by equating the square area with the square area, calculating the square area of the formula, calculating the square area of the formula, using the move of the segment, calculating the circumference of the square. She is incapable of giving any reason for any completion steps, such as not knowing why equating the second area of waking and looking for the sides first, not knowing the purpose of searching around the square. She examines the answers obtained by looking back at the answers and ways that have been done as well as calculating and ensuring the two wake areas are equal.

3.1.3. Relational Understanding of Quitter Subjects in Solving Quadrilateral Problems. At the stage of understanding the problem, she writes and declares what is known to be important points in the problem, such as the length of the rectangle and its size, the width of the rectangle and its size, and the square area equal to the area of the rectangle. In addition, the subject can distinguish the two wakes by drawing a square and square rectangle along with its size. She states and writes down what is asked as to what is being asked about the given problem. She mentions the concepts contained in the problem of the square area, the area of the rectangle, and the circumference of the square.

The next stage of the subject is to plan the settlement by linking the stated concepts of the subject to the given problem, such as determining the length and width of the rectangle, searching for the area of the two fields, looking for a square circumference. She could not give reasons for what is planned, such as why using the step equate the two wake-ups and do not know why look around the square.

At the problem solving stage, she determines the square and square lengths, symbolizes the square side by \( x \), calculates the square area equal to the rectangle, finds the square side, calculates the square circumference with the formula. She encounters errors when determining the value of \( x \) (the square) and calculate the circumference of a rectangle (Figure 2). The subject is incapable of giving reasons for steps taken in solving the problem. The subject checks the answers obtained by looking back at the answers and steps that have been done, aware of errors that have been done but do not want to improve the answer.

3.2. Discussion

3.2.1. Similarities of Junior High School Student Relational Understanding. 
Based on the results of problem-solving tasks and interviews on the three subjects obtained some things about the equation of understanding between the three relational. Here are the relational understanding equations of the three subjects. At the stage of understanding the problem, they are both able to declare...
and write down what is known and asked by using their own language, the three subjects can state the concepts related to the given problem. At the stage of devise a plan, they are both capable of completion by connecting the stated concepts, such as equating the two areas and searching for square circumference using the formula. At the stage carrying out the plan phase, they are equally able to solve the problem by using the square formula and the square formula, looking for the square side, calculating the square circumference with the formula. At the stage of looking a back, they able to re-examine the steps obtained and the answers obtained.

3.2.2. Differences in the relational understanding of junior high school students.

In this research, there are some differences of relational understanding in solving quadrilateral problem done by subject with AQ climber, quitter, and camper category. This is as stated by Stolz (2008) that AQ affects a person in response to a problem. Here are the differences of students’ relational understanding with the category AQ climber, quitter, and camper.

Table 2. Differences in the relational understanding of Subject based on AQ

| AQ Categories | Differences Of Relational Understanding |
|---------------|----------------------------------------|
| Climber       | She has solved the problem with the correct answer. In addition, the subject has been able to give reasons for every step taken during the planning phase and the stage of solving the problem. |
| Camper        | She quickly felt satisfied when plan and resolve the problem with the correct answer, although it can not give a reason why the procedure or steps are used |
| Quitter       | She feels difficult and afraid of failure when solving the problem, consequently the subject has errors in calculating and determining the final answer. The subject also can not give a reason for every step of planning and settlement that has been done. |

4. Conclusion

The results showed that, at the stage of understanding the problem, the three subjects are able to state and write down what is known and asked, and able to mention the concepts associated with the quadrilateral problem. The three subjects plan the solving strategy by linking concepts relating to quadrilateral problems. The three subjects were able to solve the problem using the procedures that have been planned. And the three subjects were able to re-check the answers that have been obtained. Subject climber, camper and quitter able to understand the problem, plan the solving strategy, carry out the plan, and look back. However, the quitter and camper subjects have not been able to give a reason for the steps they have taken.

References

[1] Skemp R R 1976 Relational Understanding and Instrumental Understanding (Coventry: University of Warwick)
[2] Skemp Richard 1987 The Psychology of Learning Mathematics (New Jersey: Lawrence Erlbaum Associates)
[3] Walle J A, Karp K S and Bay-Williams J M 2010 Elementary and Middle Schools Mathematics Teaching Developmentally Seventh Edition (New York: Allyn & Bacon)
[4] Polya G 1973 How To Solve It (2nd Ed) (Princeton: Princeton University Press)
[5] Krulik, S and Rudnick J A 1987 Problem solving: A handbook for teachers (2nd Ed) (Boston: Allyn and Bacon)
[6] Stoltz P G 2004 *Adversity Quotient: Turning Obstacles Into Opportunities* (Jakarta: PT Grasindo Indonesia)