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Student Thinking Process In Solving Open-Ended Problem Of The PISA Model Of Space And Shape Contents Based On Adversity Quotient (AQ)

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Abstract:
The purpose of this research is to describe the thinking process of students with high AQ (Climber), medium AQ (Camper), and low AQ (Quitter) from grade VIII-C students of Junior High School 2 Jember in solving open-ended problem of PISA model of Space and Shape based on Polya's problem- solving. This research is a descriptive research with the qualitative approach. Data collection methods which are used are tests, interviews, and questionnaires. In this research, data analysis is done using descriptive analysis. The data analyzed in this research is the answer sheet for the student about the problem of mathematical problem-solving test and interview result. The results of the analysis show that each subject is different based on the thinking process. A Student with high AQ (Climber) shows a lot of equilibrium in it through the stage of assimilation and accommodation. Students with medium AQ (Camper) show a lot of assimilation and accommodation conditions are also slightly disequilibrium. Students with low AQ (Quitter) show a lot of disequilibrium, assimilation, accommodation and a little equilibrium**.**

Keywords: Adversity Quotient (AQ), Thinking Process, Problem Solving, PISA Model Tests of Space and ShapeContents.

1. Introduction

The position view and role of mathematics according to Wijaya (2012:5), it is mathematics as a way to think. This view begins with how the logical and systematic character of mathematics play a role in the process of organizing ideas, analyzing information and drawing conclusions among data. In learning and studying mathematics and solving math problems, students do the thinking process until finally, students get answers. However, in fact, in learning mathematics, this thinking process receives less attention from teachers. Whereas, one of the goals in learning mathematics is to help the students to reveal how the process goes in his mind when the students solve problems, just as the teachers ask the students to tell the steps that are in their mind. It is necessary to know the errors that occur and tidy up the network knowledge of students. This is necessary because if the students have good thinking skills then the students will be better at understanding and mastering the mathematical concepts that have been studied. Santrock (2011:7) says that thinking involves the activity of manipulating and transforming information in memory. Thinking to form concepts, reasoning, thinking critically, making decisions, thinking creatively, and solving problems. While Hudojo (in Siswono, 2002: 45) states that in the process of learning mathematics, there occurs a process of thinking. In the process of thinking, people will establish relationships between parts of the information recorded as the meanings, then the concepts are inferred.

2.

According to Piaget (in Solso, 1995) says that the thought process is very important because knowledge can only be built into one's mind. Piaget (in Solso, 1995) explains that one's cognitive development has three elements, namely: cognitive content, cognitive function, and cognitive structure. Cognitive content is what a person knows. Cognitive function indicates the nature of the intellectual, such as assimilation and accommodation that is constant and continuous throughout cognitive development,

while the cognitive structure is the organization of schemata. The development of cognitive structures can only work if the student assimilates and accommodates stimuli from his environment. Furthermore, the thought process is examined based on the assimilation and accommodation framework of Piaget (in Solso, 1995). He says that when someone interacts with the environment (including math problems), there will be a process of adaptation. At the time of adaptation, a person experiences two cognitive processes, namely assimilation or accommodation.

3. In the process of thinking, there is a process between incoming information and the schema (cognitive structure) in a person's brain (Subanji and Supratman, 2015: 62). The experience or new information which is received will be adjusted through the process of assimilation or accommodation (Simatwa, 2010: 366). The cognitive process that occurs when one integrates a new perception, concept or experience into a scheme already in his mind is called assimilation (Subanji and Supratman, 2015: 64). Whereas, accommodation is the process of integrating new stimuli through the creation of new schemes or changing old schemes to adjust to problems encountered (Subanji and Supratman, 2015: 64). Mathematics is closely related to the problem. When a person is faced with a problem, one's cognition experiences a disequilibrium (unequal) condition that is usually characterized by questioning what is the problem, how to solve a problem, or why it may be so. In the presence of disequilibrium will lead to the process of assimilation and accommodation. Both of these processes take place continuously until equilibrium occurs (equilibrium) (Susanto, 2011: 65). At each Polya's settlement step, one will experience a thought process based on the assimilation and accommodation framework.

In learning mathematics with problem-solving, students are certainly faced with a problem both open and closed issues. Polya (1973) suggests four stages of problem-solving in mathematics, namely: (1) understanding the problem, (2) making a plan, (3) implementing the plan of resolution, and (4) looking back at the complete solution. Mathematical learning that utilizes the use of open questions provides an opportunity to further explore students' thinking skills comprehensively. According to Takahashi (2006), the open-ended problem is a problem that has many solutions or settlement strategies.

The current math learning is still procedural. Students are not yet accustomed to solving non-routine problems so high-level thinking skills such as their mathematical problem-solving skills have not been trained. Though this ability is required by students to be able to develop, to understand the concepts, and to be able to solve mathematical problems. Furthermore, we should use the PISA results to improve the quality of our mathematical education and learning. Based on the PISA survey, it shows that students are weak in geometry, especially in understanding space and shape. One of the causal factors is that students are poorly trained in solving problems with characteristics such as questions on TIMSS and PISA. Based on the above ideas, the PISA model is very suitable to know how far the thinking process of students in solving the open-ended problems PISA model.

In solving math problems, everyone has different ways and styles of thinking because not everyone has the same ability to think. From here, Adversity Quotient (AQ) is considered to have an important role in solving the problem. According to Stoltz (2000), AQ is one's intelligence in coping with and overcoming adversity. To illustrate, Stoltz (2007: 18) borrows the terminology of mountaineers into three parts: climber, camper, and a quitter. Thus, Stoltz (2007: 139) divides AQ into three categories: (1) high AQ (climbers) is a group of people who always strive to reach the peak of success, continue to survive and struggle against various obstacles, (2) medium AQ (campers) is a group of people still have a desire to respond to the challenges that exist, but they quit because they feel that it can no longer be easily desperate and (3) low AQ (quitters) is a group of people who lack the will to accept challenges in life, preferring dodge, easy to despair, easily give up tend to passive and lack of determination to reach the peak of success.

Based on the description above, this research is needed entitled "Student Thinking Process In Solving Open-Ended Problem Of The PISA Model Of Space and Shape Contents Based On *Adversity Quotient* (AQ).

2. Research Methods

In this research type of research which is used is descriptive research with a qualitative approach. In this study, there are three students who are selected as research subjects of each category of high AQ (climber), medium (camper) and low (quitter) in class VIII-C. The research instruments which are

used in this research are a researcher, Adversity Response Profile (ARP), test, interview guide, and validation sheet. The researcher is the main instrument that can not be replaced with other instruments because researchers act as planners, gatherers, analysts, interpreters and eventually they become reporting research results. Whereas, others are supporting instruments.

Data collection is begun by providing an Adversity Response Profile (ARP) questionnaire that is used to group students into three categories: climber, camper, and quitter students. The ARP used is a valid instrument to measure people's response to adversity. The next step, giving the three open-ended problems of PISA model to three students who have been selected in each category. Prior to the three subjects, the open-ended model of PISA must be tested for validity and reliability test in order to obtain valid and reliable research results and it is obtained from valid and reliable instruments. Test validity is given by validation questionnaires to one lecturer S2 and two lecturers of mathematics education of Universitas Jember while the reliability test is given by the whole problem that is to be done by one class student in the different class that is class VIII-A SMP Negeri 2 Jember.

From the results of validity and reliability test, it is obtained that the problem is valid and has the high reliability that can be used in research. The final step is an in-depth interview to find out the students' thinking process in solving the open-ended problems of PISA model.

The researcher analyzes the data by exposing data from test results and interviews that have been done. This analysis is the main objective of the study, which aims to describe students' thinking processes with high AQ (Climber), medium AQ (Camper) and low AQ (Quitter). This analysis is done per step by using Polya's stage. In this research, it is used triangulation method and triangulation investigator. Triangulation method is done by comparing information or data between test and interview result. Then, the triangulation of investigators conducted by requesting the help of other observers who always attend when the research is conducted.

3. Result and Discussion

The results of the AQ questionnaire analysis of 36 students are obtained by 3 students classified as climbers, 15 students as campers, and 1 student as quitters. Furthermore, the researcher selects students from each AQ category to be the subject of the study. The selected subjects in each category solve three open-ended problems of PISA model based on Polya's step which will be analyzed the thinking process. Here is a description of students' thinking process with high AQ (climber), medium (camper) and low (quitter) in solving three problems which are given in accordance with the Polya's solving stage. Analysis of thought processes is based on the results of written tests and interviews in solving problems of the PISA model. The results of the analysis show that each subject is different in the thinking process.

a. Thinking Process of Climber Students (S1) in Solving Mathematical Problems of PISA Model

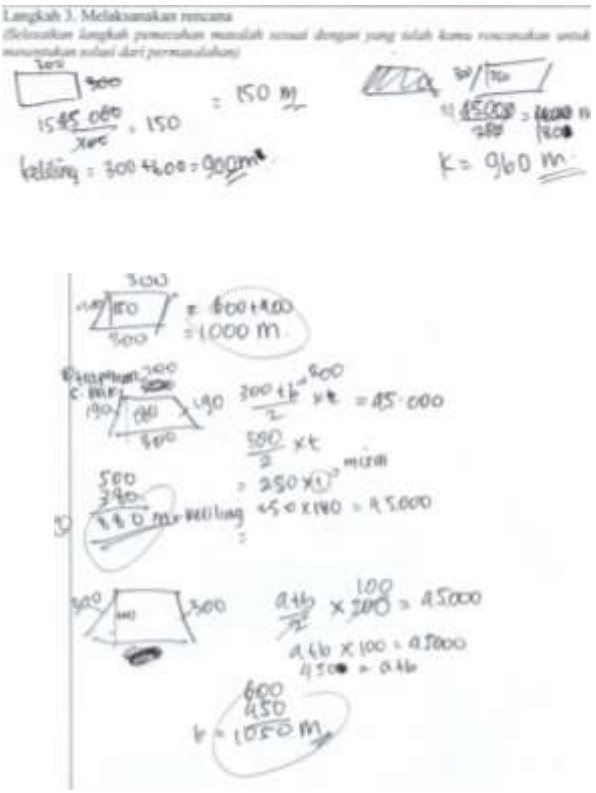


Figure 1: Answer result Climber students (S1) in step 3, implementing the plan of resolution

S1 in solving open problems will experience a series of thought processes in accordance with the Polya's solving step. At understanding the problem, S1 experiences high assimilation on each issue capable of deciphering what is known, what is unknown, and what is asked spontaneously and correctly. However, in problem 2, S1 slightly experiences disequilibrium. This is visible when S1 works on the problem, S1 seems silent for a moment and experiences confusion in understanding the intent of the problem but it did not last long. In addition, S1 experiences accommodation while trying to understand the intent and linkage of information with the given problem and producing

the correct answer. This shows that in understanding the problem, S1 integrates a new stimulus through the establishment of a new scheme to adapt to the problems at hand. Thus, S1 also uses the accommodation thinking process in understanding the problem.

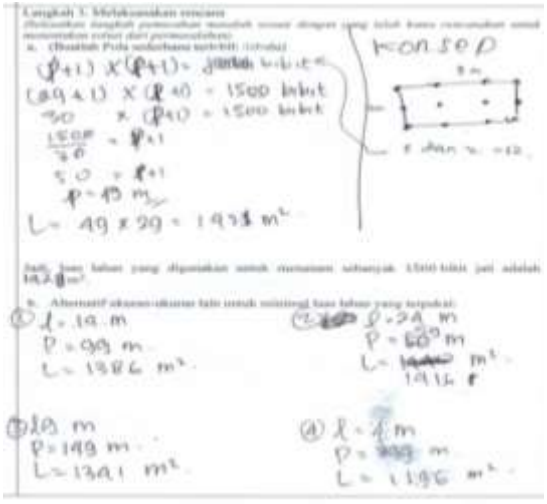
At the planning stage, S1 feels high assimilation by writing down the answers as she knows when she matches during the interview, S1 gives the correct answer also using the accommodation thinking process. S1 is able to make a connection to the problem of the given PISA model. Thus, it has been able to devise a plan to solve the problem when he is investigated through interviews, S1 is able to give the reason smoothly and correctly until finally there is equilibrium. For example, S1 mentions the concept by using the square rectangle formula, but she tries to match the number of seeds on the problem, the result is less appropriate. Then, he does by making the dots as seeds on the smaller size permissions and finally gets the right answer. From here, S1 changes the existing scheme in his mind to be modified with the information that she gets in the matter. Furthermore, she is able to do the calculations correctly to get the correct answer from the problem. The situation occurs because the provided stimulus is compatible with the scheme that has been formed in her mind.

Figure 2: Answer result Climber students (S1) in step 3, implementing the plan of resolution

When she is interviewed, S1 experiences accommodation when she is asked to provide reasons for choosing these steps until finally, she gets the correct answer. In addition, she can also answer the initial steps that must be done correctly to find a variety of alternative answers to the given problems until there is equilibrium. From the initial reply given, she is able to express other answers, such as looking for measures related to rectangles, trapezoids, and parallelogram, searching for a maximum number of viewers by changing the sizes used and she can search for a smaller area of land given. Initially, S1 cannot write down the solution neatly. However, she is investigated during the interview, S1 is able to explain fluently even though S1 is initially less skilled at communicating what he has thought, even though it is actually true. However, it can be overcome because he is trying to explain well what is on his mind. Thus, S1 uses the process of assimilation and accommodation thinking in implementing the plan of resolution.

At the look the back, there is a thought process experienced by S1. It is able to recheck the solutions that are obtained through recalculation and can ensure that the results that are obtained are correct. S1 is no longer experiencing disequilibrium because S1 has already understood the desired intent in step 4 even in school learning activities, check back step is rarely done. Thus, at the step of rechecking, S1 is through a high assimilation process to the equilibrium state. When she is interviewed and asked whether she feels confused and has difficulty in the step of checking again, the S1 answer is not confused because there is already a description of it, based on step 3. Thus, S1 uses a high assimilation thinking process at the recheck stage.

b. Camper Student Thinking Process (S2) in Solving Mathematical Problems PISA Model



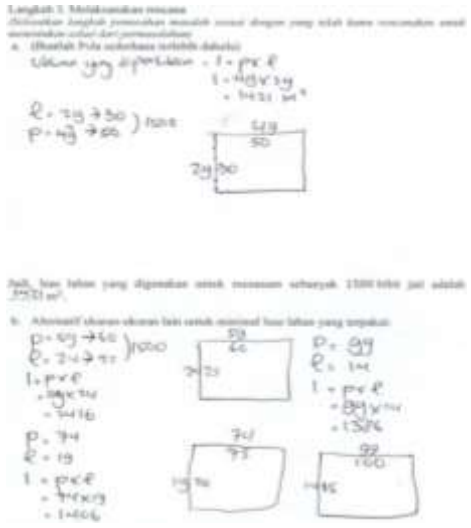


Figure 3: Answer result Camper students (S2) in step 3, implementing the plan of resolution

S2 in solving open problems experiences a series of thought processes in accordance with Polya's solution. In the step of understanding the problem, S2 does not experience disequilibrium. S2 begins to understand and tries to understand the purpose of the problem. S2 experiences assimilation when it can decipher what is known and what is asked smoothly and correctly at the stage of understanding the problem. Similarly, he can describe the problem at the time of the interview. On problem 1, he says that there is a rectangular garden, one of its sides is known and asked to determine the distance traveled as to find its circumference. In problem 2, S2 can spontaneously spell out, that there is a rectangular field with a circumference of $200\ m$ and is required to determine the number of spectators present. However, in Problem 3, S2 is disequilibrium because S2 cannot understand some sentences on the problem and there is some missing information that makes it slightly confused. For instance, he is confused to determine the shape of the land because according to S2 is not known the form. In addition, S2 also never encountered the problems given. Thus, S2 uses the process of accommodation through a state of equilibrium at the stage of understanding the problem.

At the stage of making the plan, initially, S2 is slightly disequilibrium. This is seen when S2 is a little confused in determining the size of the land whereas the 1500 seeds are known. He seems still hesitant in determining the initial step because there is land 1 hectare. After being given time to think, he can determine the steps he does by involving his reasoning skills. This suggests that in preparing non-routine plans such as the PISA model, S2 modifies the existing scheme to match the information provided. Thus, S2 uses the assimilation and accommodation process even though there is a lack of proper planning.

At the stage of carrying out the plan, initially S2 experiences (disequilibrium) in some alternative solution of an open-ended nature. However, with little explanation during the interview, S2 experiences assimilation when he is looking for the correct solution even though some calculations are not quite accurate. However, when he is interviewed, S2 can find the solution again and he gives the reason smoothly and correctly to the equilibrium state. S2 is experiencing moderate accommodation when he is asked to find other solutions to solve the problem because S2 does not immediately seek other solutions, but he still asks if the answers may vary. From this, it shows that there is a new scheme of information obtained and attempted to match the stimulus provided. Therefore, he is able to express other answers, such as looking for measures related to rectangles, trapezoids and parallelogram although there is still a less precise answer, looking for a maximum number of viewers by changing the sizes used, and he can find the area of land smaller than that provides with reasoning ability. Thus, S2 uses the process of assimilation thinking, accommodation in implementing the plan.

At the look the back, S2 still experiences a series of thought processes on each given problem. S2 is slightly disequilibrium due to he pauses for a moment and does not immediately work on the step look the back. During the interview, S2 is a little hesitant in answering the steps that are taken to get correct the obtained answers because S2 previously has never encountered steps related to checking workmanship. With a little explanation given, S2 can understand what is meant in the checking step by using the schematic that has been formed in his mind by looking at the results in step 3 and reading again the problem. S2 modifies the schema that has already formed in his mind. This situation occurs because the information it receives does not match the schema already established in his mind, so he needs to make adjustments and changes the scheme to match the information received to the equilibrium state. Then, S2 through disequilibrium stages, assimilation, and accommodation in looking the back complete solution.

c. Thinking Process of Quitter Students (S3) in Solving Mathematical Problems PISA Model

Figure 4: Answer result Quitter students (S3) in step 3, implementing the plan of resolution

S3 in solving open problems experiences a series of thought processes in accordance with Polya's solving steps. The S3 is in disequilibrium when she cannot understand a part of the sentence on the problem and what is being asked for every given problem. Then S3 has a low assimilation stage when she can describe what is known and ask according to what is on the question sheet. Although there are still some things that are complete and precise less. From the analysis result of student's answer on the answer sheet and interview, it can be explained that S3 has difficulties in understanding the problem. Moreover, the problem is nonroutine as in the matter of PISA model. The S3 is confused when she encounters a quadrilateral garden problem and is asked to determine the distance to encircle and the size of the land used to produce a smaller area. Thus, S3 experiences accommodation at the stage of understanding the problem.

At the planning stage, the S3 experiences medium assimilation when she is asked to articulate whatever is done in making a plan. Because of S3 can write and convey what she knows in spontaneously planning the plan without having to think about the truth of the answer. After being searched more deeply through interviews, S3 writes the answers to the stage of making a plan with trial and error, as well as on the written matter of a rectangle so that he writes out the formula of the area and the circumference of the rectangle. Then, he is confused when asked the next step. This shows that S3 does not change the information scheme in thinking. However, she just writes down from what he knows only. Thus, S3 experiences assimilation at the planning stage.

Based on the results of the work on the answer sheets and interviews. There is found that S3 experiences disequilibrium at the stage of implementing the plan because she is unable to solve the problem without the help of others. She just keeps quiet and confused and he says how. After the researcher gives an explanation and some guidance when she can get the answer and do the calculation of the problem although there are still some answers that are less precise. S3 also experiences low accommodation when he is able to answer questions that are open-ended. Similarly, when he determines the rise of the quadrangle that surrounds the garden and determines its circumference, there are still incorrect answers, when he is asked to determine the measures on the land planted with seeds, he also does not get the correct answer and cannot determine the other size to get a smaller area also not done because S3 feels the problem is difficult and cannot solve it. This shows that S3 has no attempt to change the schema in his mind by matching the information provided. Thus, S3 experiences low accommodation at the stage of implementing the plan.

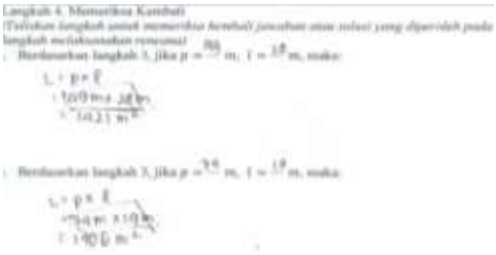


Figure 5: Answer result Quitter students (S3) in step 4, looking back at the complete solution

Based on the results of the work on the answer sheet and interviews. There is found that S3 experiences disequilibrium at the looking the back because she is confused in answering the step. For instance, she asks how to do it. S3 experiences assimilation when she merely combines the answers she obtained in step 3. Although initially, he asks the researchers for explanations about the steps she should take in the looking the back. This situation occurs because the information it receives does not match the schema already established in her mind, so it needs to make adjustments and to change the scheme to match the information received. Thus, S3 experiences low assimilation at the looking the backstage.

Apparently, S3 cannot try to use the thinking process because of every encounter problems, S3 always asks the researcher even she looks desperate, easy to give up and do not can to do if not get guidance on something that cannot be difficult or difficult.

4. Conclusion

Based on the results of data analysis and discussion, the following conclusions can be obtained.

a. Students with high AQ (climber), in understanding the problem they use the accommodation thinking process, in devising plan uses high thinking accommodation processes, implementing plan uses assimilation and accommodation thinking processes while looking the back using high assimilation thinking processes. Of all the problems given, students with high AQ (climber) are able to go through the process of thinking about the equilibrium stage because she answers correctly and able to provide several alternative answers when she is asked to answer more than one answer because the given problem is open-ended on the end result. It can be seen on the results of written tests and interviews conducted, she has a high spirit and ambition to give the best results by providing the right reasons.

b. Students with medium AQ (camper), in understanding the problem, he uses the accommodation thinking process, in making plans and implementing plans, he uses assimilation and accommodation thinking processes, while looking the back, he uses disequilibrium thinking, assimilation and accommodation processes. Of all the problems given, students with medium AQ (camper) are able to go through the process of thinking until the equilibrium stage and can answer every question given correctly and smoothly there are still some things they experience disequilibrium. They are also able to provide several alternative answers correctly in accordance with the command on the problem. These students have a passion for solving it and try to give the best result and are also able to provide excuses by involving the ability of reasoning.

c. Students with low AQ (quitter), in understanding the problem, she uses the accommodation thinking process, in making plans, she uses assimilation thinking processes, in implementing the plan, she uses the low thinking accommodation process while in looking the back, she uses low assimilation thinking processes. From the results of tests and interviews, this student is less able to solve non-routine open-ended problems and she is also easily desperate when asked to do a problem that he felt difficult. Thus, the answer she gives is sober and the lack of desire to finish it right.

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