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Analysis of Underachiever Students' Mathematical Problem-Solving Ability on The Topic Circle Viewed from Adversity Quotient

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ABSTRACT

This study aims to: (1) Know the mathematical problem-solving abilities of underachiever students, (2) Adversity Quotient profiles of underachiever students, and (3) The relationship between Adversity Quotient and mathematical problem-solving abilities of underachiever students. This research is a qualitative research type underachiever case study. The research subjects were 6 underachiever students in 2nd grade at SMA Negeri 6 Bogor and SMA Negeri 1 Babakan Madang. The instruments used in this research were the ARP (Adversity Response Profile) questionnaire and a mathematical problem-solving ability test. Data analysis in this study aims to determine the Adversity Quotient profile using Stolz's theory and mathematical problem-solving abilities based on Polya's steps. The results showed that underachiever students had Camper and Quitter type of Adversity Quotient profiles. Underachiever students with a Camper profile have pretty good mathematical problem-solving abilities. Meanwhile, students who had Quitter profiles have very less good mathematical problem-solving skills.
***Keywords**: problem-solving, underachiever, adversity quotient.*

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INTRODUCTION

Junedi, Mahuda, and Kusuma (2020) and Prayogi (2020), NCTM (2000) state that problem-solving skills are one of the abilities students must have in the 21st century to achieve success. Problem-solving abilities are also important in learning mathematics. Padliani, Bennu and Rizal (2019) stated that solving problems in mathematics is an effort that students have to solve math problems by involving all the knowledge and experience they have. Students' mathematical problem-solving in Indonesia is still relatively low. This was proven based on the results of the 2018 PISA (Program for International Student Assessment), in the mathematics category Indonesia was ranked 7th lowest (73) with an average score of 379 (OECD, 2019). Asdarina and Ridha (2020) argue that PISA questions contain mathematical problem-solving abilities. Students at SMAN 1 Babakan Madang and SMAN 6 Bogor also experienced low mathematical problem-solving skills. Many students cannot solve mathematical problem-solving questions correctly and have low learning outcomes. One of the topics that require students to solve mathematical problems contextually is a circle topic (Arofah and Noordyana, 2021).

In the circle topic, most students had difficulty with contextual problems solving. This also happened to students at SMAN 1 Babakan Madang and SMAN 6 Bogor who had high IQs, but their learning outcomes were below the minimum completeness criteria. Discrepancies in student learning outcomes with abilities are called underachievers.

Sewell and Goings (2020) stated that underachievers are students who have an imbalance between potential, abilities, and learning outcomes being tested. The categorization of underachiever students is carried out by comparing learning outcomes with students' IQ. Research conducted by states that underachievement is experienced by students with IQ $\geq$ 120 in the superior category. Hakim (2020) revealed that one factor influences the ability to solve mathematical problems and student learning outcomes, namely the adversity quotient.

Stoltz, (2000) revealed adversity quotient is the ability that a person has in observing and managing difficulties by using the intelligence they have, thus making it a challenge to solve. Adversity Quotient is classified into types : Quitter, Camper and Climber (Stoltz, 2000). Based on the research conducted by Jemina and Sulatra (2022) and Muhayana, Sridana, and Prayitno. (2021), Hulaikah, Degeng, and Murwani (2020); Merianah (2019); and Nurlaelah and Ilyas (2021) state that there is a relationship between the Adversity Quotient on learning outcomes and students' mathematical problem-solving abilities. Based on previous research, the relationship between the Adversity Quotient of underachiever students and their mathematical problem-solving abilities was examined. Therefore, researchers want to determine how the mathematical problem-solving abilities of underachiever students on the circle topic are viewed using the Adversity Quotient.

The formulation of the problems in this study includes the following: (1) How is the Adversity Quotient owned by underachiever students? (2) How mathematical problem-solving abilities of underachiever students? (3) What is the relationship between Adversity Quotient and mathematical problem-solving abilities of underachiever

students? The specific objective of this research was to provide an overview of the mathematical problem-solving abilities and adversity quotient of underachiever students. So that it can provide an overview for teachers to make appropriate learning methods and media so that underachiever students can optimize their abilities.

RESEARCH METHODS

The research method used in this study is a qualitative research method with a descriptive approach. Moleong (2021) states that qualitative research is research to understand the phenomenon of what is experienced by research subjects and by means of descriptions in the form of language in a special natural context and by utilizing various natural methods.

This research uses a qualitative case study. This study analyzes the case of underachiever students. This case, including a unique case, requires further research so that these students can show their maximum performance in learning. The research participants were selected based on the criteria for underachiever characteristics based on learning outcomes below the minimum completeness criteria and IQ ≥120 (Rahmawati, 2013; Dalimunthe, 2020; Steenbergen-Hu et al., 2020). The research subjects in this study were 6 students who were indicated as underachiever students

This research was conducted in two schools which are SMAN 6 Bogor and SMAN 1 Babakan Madang. The research instruments used included: Adversity Quotient questionnaire, mathematical problem-solving abilities test and interview guidelines. The procedure for collecting data, first by conducting an ARP (Adversity Response Profile) questionnaire to determine the Adversity Quotient profile of underachiever students. The results of ARP are interpreted according to Hakim's theory (2020) to determine the Adversity Quotient profile.

Table 1 Adversity Quotient Category according to Hakim

Score	Profle AQ
< 60	*Quitter*
60 - 134	*Campers*
>134	*Climbers*

Subsequently, a mathematical problem-solving ability test was conducted that included indicators according to the NCTM and Polya steps. The indicators used in this study were as follows:

Table 2. Indicator of Mathematical Problem-solving Ability

Polya's Problem-solving Step	NCTM Mathematical Problem-solving Ability Indicator
Understanding the Problem	• Write down the information presented in the problem • Write the quotients on the answer
Devising a plan	• Develop a problem-solving plan using clear procedures • Estimate problem-solving plans that will be used • Presenting problems in more understandable language
Carring out then plan	• Solving problems based on a strategy that has been develop • Complete problem-solving steps to communicate conclusions

Looking back	• Looking back the results of the settlement • Using different ways to solve problems

Scoring guidelines for each step in problem-solving using a modified scoring rubric from Pradiarti & Subanji, (2022) as shown in Table 3.

Table 3 Scoring Guidelines for Mathematical Problem-solving Ability

Polya's Problem-solving Step	**Description**	**Score**
Understanding the Problem	• Does not provide information that is known and asked in the questions	0
	• Provide information that is known and asked in the questions but is not complete	1
	• Provide complete information that is known and asked	2
Devising a plan	• There is no problem-solving procedure	0
	• Provide a solution plan by drawing pictures, examples, mathematical models, and associating topics with problems but not quite right	1
	• Provide a solution plan by drawing pictures, examples, mathematical models, and associating the topic with the problem correctly.	2
Carring out the plans	• No resolution	0
	• Carry out solutions but write wrong or partially correct answers	1
	• Carry out most correct solutions	2
	• Carry out solutions and write answers completely	3
Looking back	• Not writing other ways and final conclusions.	0
	• Write down the final conclusion or other inappropriate way	1
	• Write down the final conclusion and other ways but one is not quite right	2
	• Write the final conclusions and other ways appropriately	3

The results of student answers are verified through interviews. The data analysis carried out in this research is qualitative according to Creswell, (2017) including: (1) preparing, organizing data, transcribing interview results and typing the results of field notes, (2) Coding the data, (3) using a code for the information obtained, (4) presenting the findings, (5) interpreting the findings with personal views, making comparisons between the findings and the theory used and mentioning limitations, (6) validating the accuracy of findings with triangulation and reflexivity procedures.

RESULTS AND DISCUSSION

1. Adversity Quotient Profile Results for Underachiever Students

Based on the results of the ARP (Adversity Response Profile) questionnaire, the underachiever students include the following:

Table 4 Adversity Quotient Profile of Underachiever Students

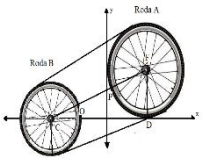
Code subject	Score	Adversity Quotent Type
S1	56	*Quitter*
S2	111	*Camper*
S3	98	*Camper*
S4	58	*Quitter*
S5	60	*Quitter*
S6	54	*Quitter*

The Adversity Quotient profiles of underachiever students that appeared in this study were Quitter and Camper types.

2. Results of the Description of Underachiever Students' Mathematical Problem-Solving Ability

The following is a matter of mathematical problem-solving abilities that have been validated by experts.

1. The machine in a factory has a wheel-shaped machine like the picture beside. Wheel A and wheel B move through a chain. With the coordinate axes, it is shown that wheel A has a radius of 6 cm and touches the x and y axes. The angle of C is 37° ($\sin 37° = \frac{3}{5}$). Wheel B has an equation $(x + 2)^2 + y^2 = 4$.



   a. What is the distance between the centers of the two wheels and the gap (OP line) between the two wheels?
   b. Calculate the distance between the centers of the two wheels using another method and draw conclusions from the answers!

2. Mount Galunggung is one of the active volcanoes in West Java province. If Mount Galunggung is depicted in Cartesian coordinates, it occupies coordinates (6.5) with units of km. and Mount Galunggung erupted, the government issued a warning to the areas closest to Mount Galunggung to evacuate. The estimated radius of the boundary of the area affected by the earthquake forms a circle equation $x^2 + y^2 - 12x - 10y + 36 = 0$. The Singaparna area is at coordinates (10.4) with units of km, while Mangkubumi is at coordinates (12.5) with units of km.
   a. What is the areas should be evacuate?

b. Check your answer using the graph and give a conclusion from the results of the answers!

Pradiarti & Subanji, (2022) state that the formula used to determine mathematicals problem-solving grades as follows:

$$N = \frac{\text{student score}}{\text{total score}}\ x\ 100$$

Below are the underachiever students' mathematical problem-solving test scores based on Polya's steps

Table 5. The score of underachiever students in mathematical problem-solving test

Question	Problem-solving Polya's Step	Subject					
		S1	**S2**	**S3**	**S4**	**S5**	**S6**
1	Understanding the Problem	1	1	2	1	1	1
	Devising a plan	0	2	2	0	2	1
	Carring out the plans	0	1	0	0	0	0
	Looking back	0	0	0	0	0	0
2	Understanding the Problem	2	2	2	2	2	2
	Devising a plan	0	2	3	0	1	1
	Carring out the plans	0	3	3	0	0	0
	Looking back	1	2	1	1	1	1
	Student score	4	13	13	4	7	6
	N	20	65	65	20	35	0

Table 6 Categories of mathematical problem solving ability levels according to Pradiarti & Subanji

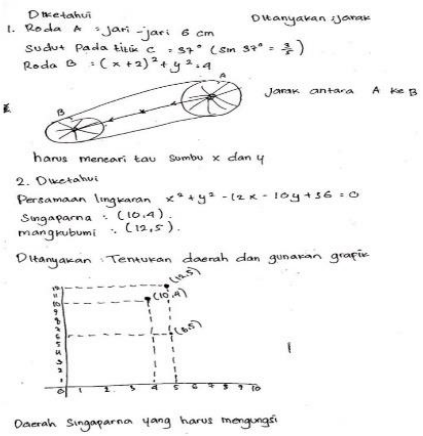
Categories	Student Score
Very good	$85 < N \leq 100$
Good	$70 < N \leq 85$
Pretty good	$55 < N \leq 70$
Not good	$40 < N \leq 55$
Very Less Good	$0 < N \leq 40$

Based on the scores obtained, the ability to solve mathematical problems S1, S4, S5 and S6 have very less good mathematical problem-solving ability. While S2 and S3 have pretty good mathematical problem-solving ability

The following are descriptions of the

subject's work on each indicator.

This is the answer of S1



Pigure 1. The answers of the mathematical problem-solving ability S1

In question 1, in the step of understanding the problem, S1 did not write down what was known completely. S1 only wrote down the radius of wheel A, angle C, and the equation of wheel B but S1 did not explain that wheel A touched the x-axes and y-axes. S1 also did not write down the questions completely, S1 only wrote down the distance. In the steps of planning the problem, carrying out problem solving and looking back, S1 did not write anything down. S1 describes only the wheel in the problem.

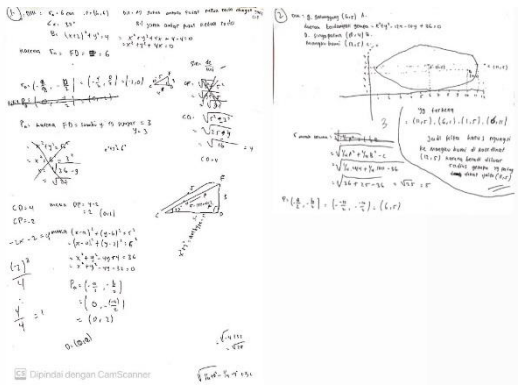
Based on S1's answer, it appears that s1 did not understand what was meant in problem 1. Therefore, s1 did not devise a plan. S1 also did not understand the concept of circles. Thus, S1 did not obtain settlement results. This was based on interviews conducted by S1.

Table 7. Results of interviews with S1

P	:	Do you know the general equation for a circle? If possible please write
S1	:	No, I don't
P	:	Do you know the formula for the general equation of a circle at the (0,0) center point ?
S1	:	No, I don't
P	:	Do you know the formula for the general equation of a circle at the(a,b) center point ?
S1	:	No, I don't

In question 2 in the step of understanding the problem, S1 wrote down what was known and asked correctly. In the step of devising a plan and carrying out problem solving, S1 did not write anything down. That was because of the lack of understanding S1 concept with circle topics. S1 did not connect the meaning of the radius can be obtained from the radius of the circle equation. S1 only describes the graph of each coordinate without the radius of the circle equation and concludes that was the Singaparna area that must be evacuated because it was the closest distance to Mount without knowing the radius.

Picture 2 is the answer of S2



Pigure 2. The answers of the mathematical problem-solving ability S2

In question 1, in the step of understanding the problem, S2 also did not write down that the spokes of wheel A touch the x and y axes but wrote down other things in the problem. In the planning problem-solving step, S2 did not write down but he said it through interviews.

Table 8. Results of interviews with S2

P	:	What steps did you take to obtain the distance and the gap?
S2	:	First we have to find the center point of the two wheels. For wheel B there is an equation, so we can substitute it with the formula. After that look for the radius of the wheel B

In the step of carring out the problem, S2 looked confused because she couldn't find the center of wheel A, because S2 did not realize that the center of wheel A touches the x and y axes. S2 prefers used other methods of trigonometry formulas. The lack of understanding of the S2 concept in trigonometry topic, it made S2 mistakes when solved the problem. S2 assumed 3/5 is the original side of the triangle. Thus, CD = 4 cm, FD = 3 cm and CF = 5 cm. The distance obtained was 5 cm. Meanwhile, the gap S2 wasn't obtained because the radius of the wheel A = 6 cm is greater than the distance between the two center points that S2 obtained. Even in the looking back step. S2 cannot provide conclusions.

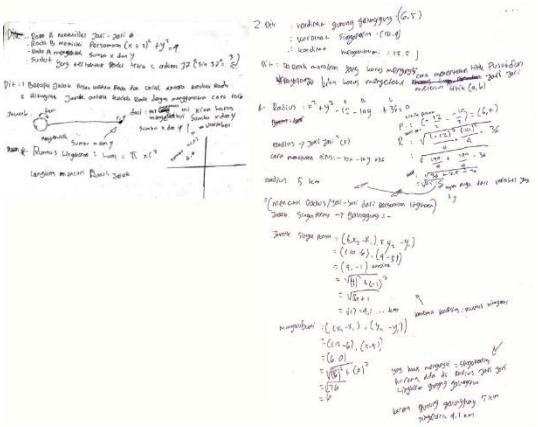
In question 2, in the step of understanding the problem S2 wrote down what was known and asked correctly. In the step of planning to solve the problem, S2 also mentioned his plans through interviews.

Table 9. Results of interviews with S2

P	:	What steps did you take to find areas that had to be evacuated?
S2	:	I have to find the radius affected by the earthquake. It will find by the radius of the circle equation
P	:	What's the next step?
S2	:	After that I added each coordinate point to each side

It can be seen from the problem-solving plan, S2 understood the problem well. In the step carring out the plans, S2 solved it well and get an earthquake radius is 5 km. In the step of looking back S2 was also able to describe the graph well, however for conclusions S2 did not understand the meaning of the word evacuate. S2 considered the areas that must be evacuated were the areas outside the radius. This can be seen from the relust conclusions of S2.

This is the S3 answer.



Pigure 3. The answers of the mathematical problem-solving ability S3

In question 1 in the step of understanding the problem, S3 wrote down what is known and asked correctly. In the step of carring out the plans, S3 did not write anything, S3 only drew the meaning of the statement wheel A touches the x and y axes. The x and y axes that S3 drew just a straight line not a cartesian graph. Based on the answers given, it can be seen that S3 has not yet understood the concept of prerequisite topic especially in making Cartesian graphs. At the step of carrying out the problems, and looking back. S3 did not write anything. S3 just wrote the area of the circle $= \pi^2$. It can be seen that S3 did not understand what you are looking for in question 1.

In question 2, in the step of understanding problems, S3 wrote down

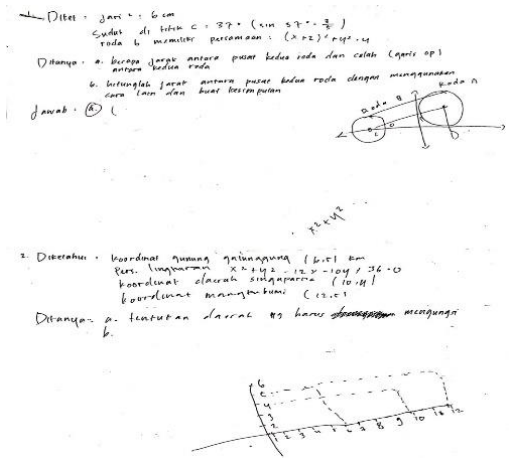
everything that is known and asked correctly. In the planning step for solving the S3 problem, S3 didn't write on the answer sheet, but explained it through interviews.

Table 10. Results of interviews with S3

P	:	What steps should you take to determine the areas should be evacuated?
S3	:	Determine the center point of Mount Galunggung and the radius of Mount Galunggung

It can be seen from the interview that S3 understood what was meant in question 2. In the step of carrying out the problem solving S3 gets the correct answer, namely with a radius of 5 km. S3 also described each radius from the center point of Mount Galunggung to Singaparna and Mangkubumi. In the step of looking back, S3 was unable to draw a Cartesian graph. This was because S3 did not understand the concept of prerequisite topic. However, S3 was able to correctly conclude that the Singaparna area had to be evacuated because the radius was 4.1 km within the earthquake radius. Based on the answers given by S3, it seems that S3 is lacking in the concept of circle topic. Formula knowledge that S3 has is only rote.

This is the answer of S4



Pigure 4. The answers of the mathematical problem-solving ability S4

In question 1, in the step of understanding the problem, S4 did not write down what was known completely. S4 did not write that wheel A touched the x and y axes, but S4 wrote the question. In the step of devising a plan, S4 did not write anything down but only redrawn question 1. This was because S4 did not understand what was meant in problem number 1. In the step of carrying out problem solving and checking again S4 didn't write anything. This is because of a lack of understanding of the concept of circle topic. Based on interviews conducted by S4, S4 did not know the general equation of the circle.

Table 11. Results of interviews with S4

P	:	Do you know the general form of the equation for a circle?
S4	:	I don't know, maybe $x^2 + y^2$
P	:	Do you know the formula for finding the center of the equation of a circle?
S4	:	I think $x^2 + y^2$

In question 2, in the step of understanding the problem. S4 wrote down what was known and asked in full. In the step of devising plans, carrying out problem. S4 did not write anything. Based on this, S4 did not understand what was meant in question 2. S4 could not interpret the equation of the circle radius of a mountain, which can be obtained using the formula for the radius of a circle. In looking back steps, S4 draws a cartesian graph without the equation of the circle as the radius. Therefore, the conclusion that S4 gives is only based on logic and incorrect. S4 provided was Singaparna area should be evacuated because this area is the closest to Mount Galunggung. This was confirmed by S4 through the interviews.

Table 12 Results of interviews with S4

P	:	What is the conclusion from the answers?
S4	:	The area that must be evacuated is the area closest to Mount Singaparna

This is the S5 answer

Pigure 5. The answers of the mathematical problem-solving ability S5

In question 1, in the step of understanding the problem, S5 did not write that wheel A touches the x and y axes. S5 also did not write down things that were not asked in the questions but verbally through interviews.

Table 13. Results of interviews with S5

P	:	What is asked in the question?
S5	:	The distance between the centers of the two wheels and the gap

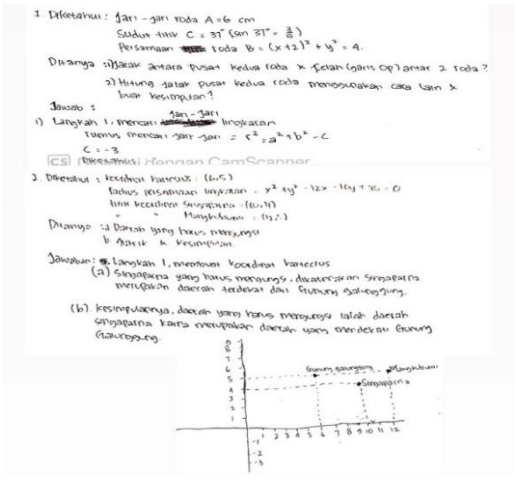
In devising plan's steps, S5 wrote down his plan, namely finding the radius of wheel B and finding the center point of the two wheels. Based on the answers S5 gave, S5 understood what problem logically meant. However, in carring out the problems step, S5 only wrote down the center point formula that S5 knew. Due to the limited understanding of the concepts of circles and formulas owned by S5. Thus S5 did not solve the problem. In looking back steps, S5 also didn't write anything. This was confirmed by the researcher through the interview.

Table 14 Results of interviews with S6

P	:	Can you explain what you wrote?
S5	:	To find the center distance the formula is $P\left(-\frac{A}{2}, -\frac{B}{2}\right)$as I know. But I don't get the result.
P	:	If equation of the circle is $x^2 + y^2 + 2x - 4x = 0$. What's A, B, and C?
S5	:	I don't know

In question number 2, in the step of understanding the problem, S5 wrote down what was known and what was asked correctly. In the step of planning the solution to the S5 problem, wrote down the steps, namely directly using a Cartesian graph. S5 did not find the radius of the equation of the circle affected by the earthquake. It can be seen that S5 did not understand what was meant problem number 2. In looking back, S5 drew a Cartesian graph without drawing the equation of a circle. The conclusion given by S5 was only based on logic and incorrect, namely the Singaparna area because the coordinate point is close to Mount Galunggung.

This is the S6 answer



Picture 6. The answers of the mathematical problem-solving ability S6

In question 1, in the step of understanding the problem, S6 did not write that wheel A touches the x and y axes. However, the S6 wrote down exactly what was asked. In the step of devising a plan, S6 only wrote inaccurately, namely only looking for the radius of the circle.

In the steps for carring out plan, just wrote the radius formula $r^2 = x^2 + y^2 - c$. Based on the interview results, S6 forgot the formula for determining the radius of a circle. When looking back steps, S6 did not write anything. Based on the answer given by S6. It can be seen that S6 did not understand the concept of circle topic.

Table 15 Results of interviews with S6

P	:	Can you explain the meaning of what you wrote?
S6	:	I wrote down the formula for the radius of wheel B, but I forgot

In question number 2, in the step of understanding the S6 problem, write down what is known and what is asked correctly. In the planning step, problem S6 answered using Cartesian coordinates. Based on the answers given by S6 it can be seen that S6 did not understand what was meant in the problem. In the step of carrying out the problem, S6 did not write anything. S6 only made graphics and conclusions that are incorrect. S6 did not draw the equation of the circle as the boundary of the displaced region. The conclusion given by S6 was also not quite right, namely the Singaparna area which had to be evacuated because it was the closest area to Mount Galunggung.

The Relationship between Adversity Quotient and Mathematical Problem-Solving Ability

Underachiever students with Camper profile have pretty good mathematical problem-solving abilities. Camper students can understand the questions well but due to lack of thoroughness in reading. They cannot write down what is known correctly. This resulted in Camper students not being able to continue problem solving steps. Underachiever students with Camper profiles can plan problem solving well. Camper students cannot carry out problem solving due to a lack of understanding of the concepts and prerequisites of the circle topic. In addition, language ability in interpreting contextual questions is one of the reasons why Camper students are unable to provide appropriate conclusions and answers.

Meanwhile, students with Quitter profiles have very poor mathematical problem-solving skills. In the steps of solving the problem, Quitter students cannot understand the problem properly so that it will result in the next problem-solving steps, namely planning problem solving, carrying out problem solving and looking back. Lack of understanding of concepts in circle topic is also one of the reasons Quitter students cannot solve mathematical problem-solving ability questions. Understanding formulas that are only rote is one of the reasons Quitter students cannot complete all the problem-solving steps.

CONCLUSION

Underachiever students have Adversity Quotient profiles of Camper and Quitter types. Underachiever students with a Camper profile have pretty good mathematical problem-solving abilities.

Meanwhile, students with Quitter profiles have very less good mathematical problem-solving abilities.

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