Beta: Jurnal Tadris Matematika, 16(2) 2023: 151-171
DOI 10.20414/betajtm.v16i2.567

Research articles

Student's ways of thinking and ways of understanding analysis in solving mathematics problems in term of adversity quotient

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Abstrak Terdapat dua kategori keterampilan berpikir yang saling mempengaruhi dalam pengetahuan matematika yaitu proses berpikir yang disebut *Ways of Thinking* (WoT), dan cara pemahaman siswa yang disebut dengan *Ways of Understanding* (WoU). Penelitian ini bertujuan untuk mendeskripsikan *Ways of Thinking* (WoT) dan *Ways of Understanding* (WoU) dalam menyelesaikan masalah matematika ditinjau dari *Adversity Quotient* (AQ). Penelitian ini adalah deskriptif kualitatif. Subjek dipilih berdasarkan hasil tes *Adversity Respons Profile* menggunakan teknik *purposive sampling*, sehingga didapatkan 3 siswa *climbers*, 3 *campers* dan 2 *quitters* di MTs Muhammadiyah 1 Taman di Sidoarjo. Data tes tulis dan wawancara dianalisis sesuai indikator WoT dan WoU. Hasil penelitian ini menunjukkan bahwa WoT siswa *climber* dalam menyelesaikan masalah matematika cenderung memiliki satu strategi yang mengarah pada solusi benar, cara berpikir empiris, dan memiliki keyakinan yang sangat baik terhadap konsep matematika. Sedangkan WoT siswa *camper* dan *quitter* cenderung memiliki satu strategi yang mengarah pada solusi salah, dan cara berpikir out of the box. Siswa camper memiliki keyakinan yang baik, sedangkan siswa *quitter* memiliki keyakinan yang kurang terhadap konsep matematika. WoU siswa *climber* berkategori sangat baik, siswa *camper* berkategori cukup. dan siswa *quitter* berkategori kurang. WoT dan WoU siswa *climber* lebih baik dibandingkan siswa *camper* dan *quitter*.

Kata kunci *Cara berpikir, Cara memahami, Adversity quotient*

Abstract There are two categories of thinking skills which influence Mathematical knowledge called Ways of Thinking (WoT) and Ways of Understanding (WoU). This study aims to describe students' WoT and WoU in solving mathematics problems in terms of Adversity Quotient (AQ). Descriptive Qualitative was implied to this study. The subjects were selected based on the results of the *Adversity Response Profile* test using a purposive sampling technique. As a result, there are 3 climbers, 3 campers, and 2 quitter students from MTS in Sidoarjo. The data collection technique was gained from written test and interview section which were analyzed based on WoT and WoU indicators. The results of this study indicated that WoT of climbers' students tended to have one strategy that led to the correct solution, an empirical WoT, and a good belief in mathematical concepts. Meanwhile, WoT of campers and quitters' students tended to have one strategy that led to the wrong solutions and they had beyond belief WoT. Further, campers' students had good confidence while quitter students have less confidence in mathematical concepts. WoU of climbers' students were good, campers' students were enough, and quitters' students were less. In conclusion, WoT and WoU of climbers' students were better than the camper and quitter students.

Keywords *Ways of thinking, Ways of understanding, Adversity quotient*

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Introduction

In the 21st century, humans are required not only to master technology but also to handle and solve problems with a strong and resilient attitude in managing new ideas and being responsive to changes (Fauziansyah et al., 2013; Marques, 2012; Sanabria & Arámburo-Lizárraga, 2017). It leads to the idea of critical thinking. This critical thinking skills can be formed and developed through mathematics (Kusaeri et al., 2022; Murawski, 2014). In learning mathematics, students need to do various exercises. When they are accustomed to doing the exercises on Math, they will realize that Math requires lots of practices to sharpen their abilities in solving various mathematical problems.

Previous studies show that the level of mathematical thinking ability, especially geometric thinking, for junior high school students in solving mathematical problems is in a low level (Junining et al., 2022; Kurniati et al., 2016; Ma'rifah et al., 2019; Megawati et al., 2019; Rabu & Badlishah, 2020). Likewise, there is a research on students' difficulties in solving geometry problems (Arifendi & Wijaya, 2018; Fauzi & Arisetyawan, 2020; Indrayany & Lestari, 2019; Maryanih et al., 2018; Sholihah & Afriansyah, 2017). One of the causes of students' lower thinking ability lies in the students' mindset which only focused on one solution without trying, analyzing and finding new ways and tended to use the same way or formula of solving problems as what has been given by the teacher. This happens because the mathematics learning process in class generally emphasizes students' mastery of calculation formulas rather than emphasize students' thinking process abilities (Nurhasanah, 2019).

Learning mathematics is in line with problem-solving and it requires a problem (Wu, 2017). According to Mujib (2015), solving mathematical problems get the students to use reason and think creatively, so the problems created must be challenging which directs students to combine all known concepts related to the problems they face and form a new concept so that the problems given can be solved. Thus, learning mathematics can be used as an exercise for students in building and developing their thinking skills (Toker & Baturay, 2021; Widyatiningtyas et al., 2015). In addition, there are two categories of their thinking skills that influence each other in mathematical knowledge which are a thinking process called Ways of Thinking (WoT) and Ways of Understanding (WoU).

Several studies on WoT and WoU have been reviewed in recent years. Nurhasanah et al., (2021) examined the characteristics of WoT that are interconnected with students' WoU in vector material. Further, in her following research regarding the implementation of WoT, students who have high, medium, and low cognitive abilities in geometry material can be reference in developing mathematics teaching materials (Nirawati et al., 2022). As a result, the difference between this study and previous ones is the material used which are lines and angles, as well as the selection of subjects based on the adversity quotient. Therefore, this study aims to describe and identify the WoT and WoU types of climbers, camper, and quitter students in solving problems on lines and angles.

Prior research

According to Nurhasanah (2019), students had difficulty with the geometry because teacher generally get students to master the calculation formula instead of having the ability of thinking process in learning mathematics during the class. Sholihah & Afriansyah (2017) study also shows that the achievement of students in the process of solving geometric problems based on Van Hiele's thinking stages is in the stage of 0 (visualization) as much as 96.87%, while stage 1 (analysis) is 3.13%, stage 2 (informal deduction) and stage 3 (deduction) does not exist. The same thing is done by Moses (2016), he states that the Van Hielle geometric thinking level of class VII students generally only reaches level 1 which means that students can recognize shapes based on their properties. According to Fauzi & Arisetyawan (2020), students experience difficulties in basic geometry such as: (1) students have difficulty using concepts; (2) students

get difficulty using principles; and (3) students have difficulty solving verbal problems. These show that the thinking skills of Indonesian students in solving geometric problems are still relatively low (Basri et al., 2019; Sandy et al., 2019).

Students had difficulty with the geometry of the cube and block material, and dynamic geometry (Lingefjärd et al., 2012; Maryanih et al., 2018). In their research, it was also found that this study also provides alternative solutions to students' learning difficulties, such as: (a) Using computer applications or software (PowerPoint, Microsoft Word with SmartArt Graphic) and software such as Cabri Geometry, The Geometer's Sketchpad (GSP), Geometry Expert, Logo, GeoGebra, Wingeom, and Maple (Alabdulaziz et al., 2021; Kilicman et al., 2010); (b) Activating prerequisite material about flat shapes that explain the sides of the shapes; (c) Applying the guided discovery method using guided worksheets; and (d) Doing more practices both contextual and non-contextual questions. By doing those activities, hopefully teachers could design a various learning process which encourage students to develop their thinking abilities (Chusni et al., 2021; Toker & Baturay, 2021).

Theoretical review

Ways of thinking (WoT) and ways of understanding (WoU)

One theory that can be the reference by teachers to see the process of learning mathematics is Harel's theory in the principle of Duality, which explains that two categories of knowledge influence each other in mathematical knowledge. They are thinking process called as Ways of Thinking (WoT) and students understanding's way which is called as Ways of Understanding (WoU) (Harel, 2008b). WoU is a collection of structures consisting of certain axioms, definitions, theorems, proofs, problems, and solutions. While WoT is all ways of thinking. It is a characteristic of a mental act performed by a person, meanwhile the product is all ways of understanding or WoU.

Students' WoT is divided into three interrelated actions, namely problem-solving approaches, proof schemes, and beliefs in mathematics (Harel, 2008a). The problem-solving approach is a way of thinking related to problem actions and is often referred to as a heuristic. One of the well-known heuristic models is Krulick and Rudnick which is divided into several stages of problem-solving (Krulick & Rudnick, 1996). These stages are: read and think, explore and plan, select a strategy, find and answer, reflect and extend (Kusdinar et al., 2017).

The following action is the scheme of its evidence and a discussion of it is needed to find out someone's way of thinking (Koichu et al., 2013). This evidence is implemented by someone to confirm himself or to convince others that the statement is true, while the evidence scheme is the collective cognitive characteristic of the proof produced by someone. The first proof scheme consists of extra-belief proof schemes which consist of ritual and authority schemes. The second is empirical which consists of proceptual and inductive schemes. The third is a deductive proof scheme consisting of transformational and axiomatic proof schemes. From the evidence scheme above, the empirical evidence scheme is a common and strong way of thinking among many students. This is because students tend to do something based on the understanding on the experiments results or examples given by the teacher.

In addition to the categories of problem-solving and proof schemes, the category of belief in mathematics is also essential, but the result of teachers' belief in Indonesia is low (Kusaeri & Aditomo, 2019; Muhtarom et al., 2017). Beliefs about mathematics are one's view of mathematics itself (Harel, 2021). Confidence is categorized into two, which are a belief in learning mathematics and a belief in the problem-solving process (Muhtarom et al., 2017). According to Nurhasanah's research, beliefs about mathematics show the extent to which students are aware of the use and relation between concepts they have and problem-solving, know the effectiveness of the methods/concepts chosen, and know the advantages of the many

interpretations of concepts that are carried out (Nurhasanah, 2019). Furthermore, there is also WoU which is a product of a way of thinking. It needs to be highlighted that mathematical understanding is not just remembering concepts or following procedures, yet the results of solving mathematical question is the main point. Thus, students are expected to deeply understand the basic of mathematics, from facts to mathematical proofs.

Adversity quotient (AQ)

Ways of thinking and ways of understanding mathematics are closely related to psychological factors, one of which is the personality that shows one's character. Everyone who has a different character must have a different way of thinking (Zhao et al., 2021). Adversity Quotient (AQ) is considered to play a role in students' thinking processes when completing mathematics. According to Stoltz (2005), he defines AQ into three forms, namely (i) AQ is a new conceptual framework for understanding and improving all aspects of success, (ii) AQ is a measurement for knowing a person's response to difficulties, and (iii) AQ is a series of scientific means to improve a person's response to adversity. Apart from that, AQ is defined as an ability that exists within a person to overcome and process difficulties using the intelligence they have so that it becomes a challenge to be resolved (Mustika et al., 2018). Therefore, from the explanation above, researchers conclude that AQ is a person's effort to overcome the difficulties they are experiencing.

AQ is categorized into three categories, which are climber, camper, and quitter (Hasanuddin & Lutfianto, 2018). Quitters are a group of people who are lack of the desire to accept challenges in their life. Whereas a camper is a group of people who already have the desire to try and face existing problems and challenges, but they stop because they feel they can't stand to it anymore, while climbers are a group of people who choose to continue to survive and struggle to face all the problems, obstacles that hit them. To find out more about the characteristics of the quitter, camper, and climber categories, see Table 1 below.

Table 1. Quitter, camper, and climber profiles

Profiles	Characteristic
Quitter	a. Refusing to climb any higher
	b. Unpleasant lifestyle
	c. Working is just enough for survival
	d. Tends to shy away from tough challenges
	e. Rarely have true friendships
Camper	a. Keep climbing until you feel enough and stop at that place.
	b. At a certain stage they feel satisfied
	c. Still have initiative and a little enthusiasm to try.
	d. Tends to build good relationships with other campers.
Climber	a. They will continue to climb by thinking about the possibilities.
	b. Their lives feel "complete" because they appreciate the small amount of time and effort they have had.
	c. Have high motivation and enthusiasm to continue to strive for the best.
	d. Not afraid to explore unlimited potential, willing to take high risks and accept criticism.
	e. Willing to accept any changes that push them in a positive direction.

Methods

This type of research is qualitative descriptive research. The descriptive methods were used to describe the students' WoT and WoU in solving mathematical problems. This research was conducted at MTs Muhammadiyah 1 Taman in Sidoarjo Regency, East Java in October 2022 for 5 days. The reason for choosing this school as a research location was because the students' conditions were heterogeneous and this school was one of the best schools in Sidoarjo Regency. This research procedure consists of 3 stages, namely the preparation stage, the implementation stage, and the final stage. In the preparatory stage, the researcher compiled the instrument, validated the instrument, made a research permittion letter to the research location school, asked for permission, and made an agreement with the teacher in conducting the research. At the implementation stage, the researcher gave ARP tests to all students via Google Forms. This ARP test is to find out a person's AQ score. After being analyzed, it is then classified based on the categories in Table 1 and selected several research subjects. In the next stage, this research subject solves mathematics questions to explore the students' WoT and WoU. The next step is each student was interviewed to explore more about the WoT and WoU processes. In the final stage, the researcher analyzed the written test data and interview data.

Moreover, the subject-taking technique was used purposive sampling in which students were selected including the Adversity Quotient (AQ) types (climbers, campers, and quitters). The steps for taking the subject began with giving the Adversity Response Profiles (ARP) test to 28 students in class VIII-A and 26 students in class VIII-B via Google form. The ARP used in this study is adoption from (Indrawati, 2019). The ARP used was not validated again because it had previously been validated and used by Indrawati. Then the ARP results which had been filled in by 54 students were analyzed by giving a score and determining their AQ category. The following AQ scores and categories are presented in Table 2.

Table 2. AQ category (Damayanti et al., 2020)

AQ category	ARP value
Climber	166 - 200
The transition from camper to climber	135-165
Camper	95 - 134
The transition from quitter to camper	60 - 94
Quitter	0 - 59

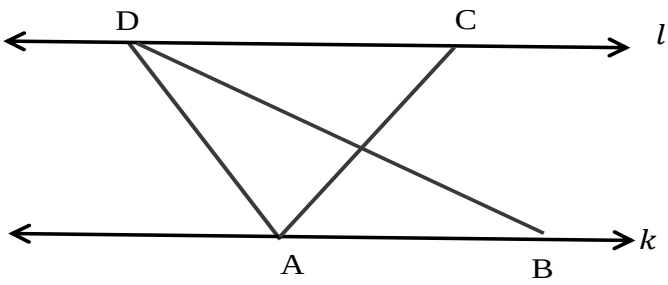
After the ARP were analyzed, it was found that 37 students transition from camper to climber (20 students from class VIII A and 17 students from class VIIIB), 5 climbers (2 students from class VIII A and 3 students from class VIII B), 3 students of the transition from quitter to camper (3 students from class VIIIA), 7 camper students (3 from class VIII A and 4 students from class VIII B), 2 quitter students (2 students from class VIII B). The subjects in this study were based on the results of the ARP and the recommendations of the mathematics teacher based on representatives of the AQ score levels starting from low, medium, and high of AQ. As a result, 8 AQ students were chosen as the subjects which consisting of 3 students in the climber category, 3 students in the camper category, and 2 students in the quitter category. In the quitter category, two students were selected because there were only two students who were included in this part as the data above. The list of selected research subjects is presented in Table 3 below.

Table 3. List of selected research subjects

No.	Name Initials	Total ARP Score	Category	Subject Code
1.	DLP	184	climbers	SC1
2.	ANR	174	climbers	SC2
3.	IN	166	climbers	SC3
4.	NDH	126	campers	SP1
5.	MFN	106	campers	SP2
6.	IFS	104	campers	SP3
7.	DD	52	quitters	SQ1
8.	IDS	56	quitters	SQ2

Data collection began with the subject being given a material problem or questions of lines and angles, then students were asked to solve the exercise. The implementation of this test was carried out offline at school. Then the interview process was carried out after completing the problem-solving exercise. The interview process was used to find out more about students' WoT and WoU in solving math problems. The interview method used was semi-structured. This interview was conducted in-depth until the data or information was obtained. The steps of this research took the following stages: (1) preparing recording devices; mobile phones and writing test instruments, (2) asking students to complete the questions that have been given, and (3) conducting interviews regarding students' WoT and WoU that couldnot be detected by recording devices. To get students' WoT and WoU which are problem-solving online test and angle material. The research instrument was in the form of one problem with 2 sub-questions and an interview guide sheet. The indicator for the written test is "to determine the size of an angle if the other angle is known as a result of two parallel lines cut by a transverse line". The written test in this study is shown in Figure 1 below.

The two instruments were validated by four validators, which consisted of two validators from mathematics education lecturers at UIN Sunan Ampel and two mathematics teachers from SMPN 2 Taman and MTs 1 Muhammadiyah Taman. The first validator had to revise the use of sentences in the instruction such as using sentences that can be understood by junior high school students. Having it done, the instrument was validated again by the second validator. In the second validating process, the instrument needed more improvement in the term of research method, especially in the written test. The revision was the test should ask about how many strategies could be used to solve this problem or questions. After being validated by the second validator, the researcher revised it again by adding the statement 'Write it down if you have more than one way or formula'. The following step was it checked by the third validator. The third validator stated that the questions are good based on the material, but the questions need to relate to junior high school students. Then, the researcher immediately changed the context of the questions which were closer to the students. After that, the fourth validator had a look and validated the instructions. There was another revision in the instructions. The revision was it should state that the answers would not affect the value of the learning outcomes in the report cards. The assessment of the four validators starting from the material aspect, the construction of the questions, and the writing and languages obtained a B grade, which means it is feasible to use with revision so that the instrument is feasible to use.



In the picture above, the line is parallel to line *l*, points A, B, and C, D respectively lie on the lines *k* and *l*. If known $\overline{CD} = \overline{DA} = \overline{AC}$, and $\angle DBA = 40°$. Define $\angle BDA,\ \angle DAB,$ and $\angle a$! Three students get an assignment from the teacher to determine the size of the angles in the picture above. Three students have different opinions about the size of the outer angle of the triangle

a) Andi, a measure of $\angle a$ is smaller than the measure of $\angle BDA + \angle DAB$
b) Beni, a measure of $\angle a$ equals the measure $\angle BDA + \angle DAB$
c) Cici, a measure if $\angle a$ is bigger than measure $\angle BDA + \angle DAB$

In your opinion, which opinion is correct? Explain!
(Write it down if you have more than one way)

Figure 1. Written test instrument

The data analysis was gained through writing test and interview section. They werecarried out by reducing data, presenting data, and drawing conclusions (Miles et al., 2020). Reducing the data in this study could be done by transcribing the interview results. As for the stages of presenting the data, it was presented in the form of a description by displaying the results of interview transcripts and it was based on the WoT and WoU indicators for each subject. The WoT indicators were presented in Table 3 and the WoU indicators were shown in Table 4 which were modified from Nurhasanah's research (Nurhasanah, 2019). Modification of the WoT and WoU indicators in this study was the proof scheme indicator, which in Nurhasanah's research that wass divided into two aspects; Result Pattern Generalization (RPG) and Process Pattern Generalization (PPG). While the evidence scheme is divided into three; deductive, empirical, and beyond belief in this study.

Table 4. WoT indicators in solving problems

Action	Category	Indicator
Problem solving approach	Very good	Have a variety of strategies and use effective and efficient strategies that lead to the right solution.
	Good	Create a problem-solving plan and allow it to lead to the correct solution.
	Enough	Create a problem-solving plan and possibly lead to wrong solutions.
	Less	Don't have a plan.
Proof Scheme	Deductive	One's way of thinking in solving problems is based on a good understanding of the concept, validating the process to produce a true statement.
	Empirical	A person's way of thinking is based on the results of an experiment. for example, substitution of answers or numbers, understanding the concept, and the resulting statement is true or false.
	Beyond belief	The way of thinking is based on non-referential symbols.

Belief in mathematics	Very good	Consciously using and connecting between known concepts to solve problems. Recognize the advantages of using and relating the selected concepts. Knowing the effectiveness of the selected concept.
	Good	Consciously using and connecting between known concepts to solve problems. Recognize the advantages of using and relating the selected concepts. Do not know the effectiveness of the selected concept.
	Enough	Consciously using and connecting between known concepts to solve problems. Do not know the advantages of using and connecting the selected concept. Do not know the effectiveness of the selected concept.
	Less	Do not know the concept formula used in solving the given problem.

Table 5. WoU indicator in solving problems

Category	Indicator
Very good	Explain the problem completely and correctly, select concepts/algorithms, explain concepts verbally and in writing appropriately, and a link between concepts in solving problems logically.
Good	Explain the problem completely and correctly, choose concepts/algorithms, explain concepts verbally and in writing appropriately, and a link between concepts in solving problems logically, but the final answer is incorrect.
Enough	Explains the problem as a whole, and explains concepts well, but is not precise in choosing certain concepts, and is unable to link between concepts.
Less	Unable to fully explain the problem, misinterpreting the problem, or unable to use concepts in solving problems and not linking one concept to another.

As for the process of conclusion, the researchers first described and analyzed the data according to the WoT and WoU indicators and based on checking the validity of the data using triangulation, then categorized them based on WoT and WoU indicators.

Findings and Discussion

The source of data for this research was 8 selected subjects who were coded SC1, SC2, SC3, SP1, SP2, SP3, SQ1, and SQ2. The answers from the results of problem-solving tests, interviews, and observations were used by researchers to identify students' WoT and WoU in solving problems on lines and angles.

WoT and WoU of climbers' students

Subjects SC1, SC2, and SC3 tended to only write one problem-solving strategy with different problem-solving approaches. In the problem-solving approach stage, SC1 used the concepts of division, subtraction, the addition of angles, and the concept of rectifier angles, SC2 used the concept of the properties of angles and equilateral triangle properties, and SC3 used the concepts of addition, equilateral triangles, the sum of triangular angles, and rectifier angles, as shown in Figure 2.

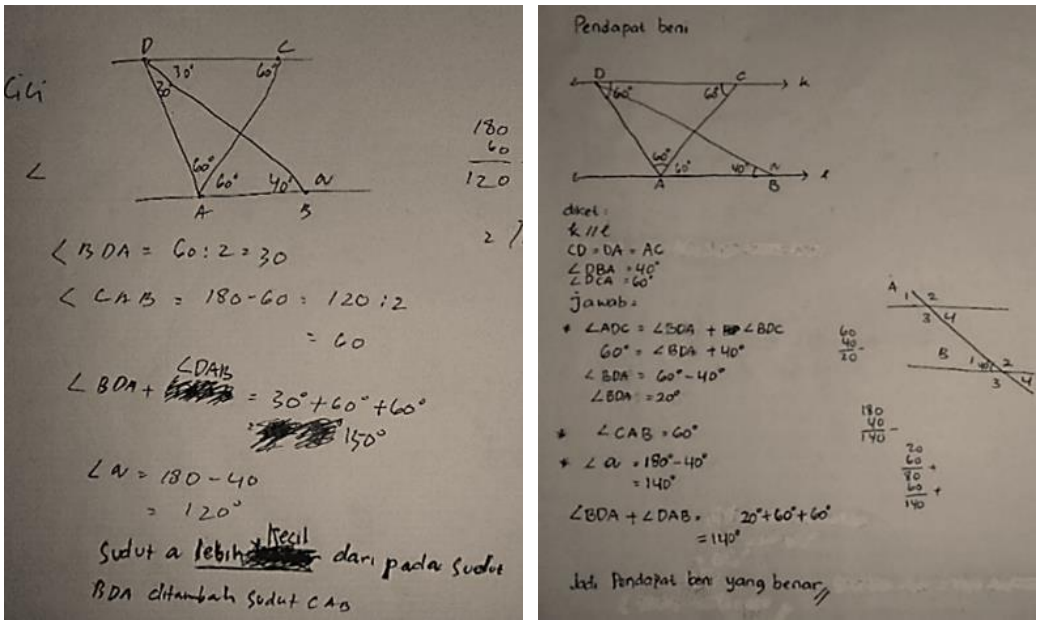


Figure 2. The results of the climbers' students' work; SC1 (left image) and SC2 (right image)

At the proof scheme stage, SC1 wrote information in graphic form, SC2 wrote information in written and graphic form, and SC3 wrote information in written form. When it came to planning, SC1 started by looking for $\angle BDA, \angle CAB,$ and $\angle\alpha$ used the concepts of division, subtraction, and addition of angles and straight angles, SC2 used the concept of angle properties, and equilateral triangles, while SC3 used the concept of addition, equilateral triangles, the sum of angles, triangles and straight angles in solving problems. Further, at the stage of choosing a strategy, SC1, SC2, and SC3 apply their strategies to find $\angle BDA, \angle CAB,$ and $\angle\alpha$. So, SC1 strategy is not quite right, while the SC2 and SC3 strategies are correct and appropriate, as shown in Figure 3.

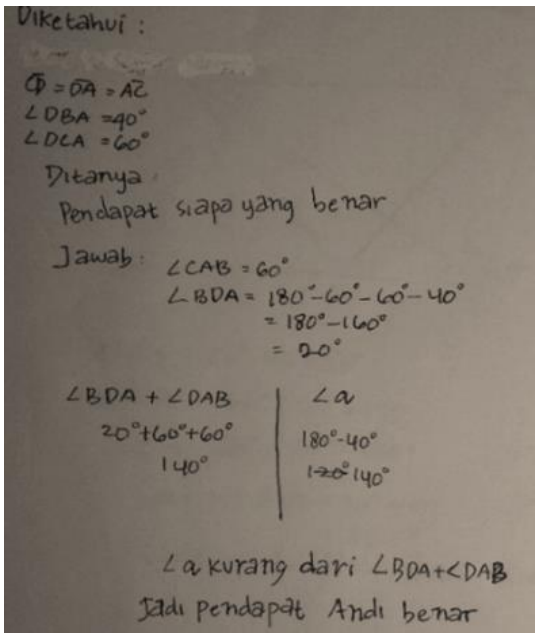


Figure 3. The results of the climber student's work; SC3

The excerpts from the interview results in Table 6 and Table 7 show that at the answer-finding stage, SC1 concluded that Andi's opinion was correct, SC2 concluded that Cici's opinion was correct but changed to Beni's opinion was correct, while SC3 concluded that Beni's opinion was correct. Then, SC1, SC2, and SC3 believed that their answers were correct. However, SC1, SC2, and SC3 re-examined the strategies that had been worked out. SC1 could solve the problem in 34 minutes, SC2 finished in 29 minutes, and SC3 completed in 24 minutes. Briefly to conclude that at the stage of the proof scheme, SC1, SC2, and SC3 are included in the empirical way of thinking.

Table 6. Transcript of subject climber's interview

Question	Transcript of SC1 interview	Transcript of SC2 interview	Transcript of SC3 interview
What plans do you have in mind to solve the problem?	Find the angle BDA, CAB, and BDA then add the angle DAB and then the angle α.	Draw first, then write down any information that is known after that search $\angle$ADB, $\angle$CAB equal $\angle\alpha$.	Write down what is known and what is asked and then search for $\angle$CAB, $\angle$BDA equals $\angle\alpha$
What concept did you use in solving the problem?	The concept of division, subtraction, and sum of angles equal supplementary angle sis.	The concept of the properties of angles, and equilateral triangles.	In addition, equilateral triangles, the sum of angles in triangles, equilateral triangles.
Explain in detail how you did the problem!	I'm confused, sis... I drew the corner first... while thinking about how to do it when I read the question again... um, something went wrong, here's sis CD = DA = AC. which means that all the angles in the ADC triangle are equal to 60 degrees. Earlier I tried to find $\angle$BDA first, $\angle$BDA if I see that it is half of $\angle$CDA, so I divide 60º divided by 2 equals 30º. Then continue searching $\angle$DAB, $\angle$DAB there is an angle that is not yet known, and I will look for $\angle$CAB this first I get from 180 minus 60 divided by 2 the result is 60º.	First of all, I first drew the angles, Sis, and gave the numbers. Then I write down any information that is known about the problem. After that I started looking $\angle$BDA ... $\angle$BDA, I got this from $\angle$ADC by subtracting $\angle$BDC. $\angle$ADC is equal to 60º. From the problem, it is known that AD = DC = CA means that triangle ADC is an equilateral triangle. Then $\angle$BDC is the same as 40º as big as the $\angle$DBA. Follow the concept of angle properties, but I forgot the name.	I am looking for $\angle$CAB Sis, $\angle$CAB it's the same as 60º. For example, if I draw this line Sis (while drawing), then I will name the angles A, B, C, D, E, F, G, and H. The angle that I mean is the angle opposite this line, like angles C and D. For example, angle C is equal to 60º. Angle C is the same as angle G, so angle G is equal to 60º. So, angle G, if the sum is equal to angle E, is equal to 180, just like angle E is the same as angle D. So, angle E equals 180º minus 60º equals 120º. If angle E has met, it means that angle D equals 180º minus 120º equals 60°.

Table 7. Follow-up transcript of subject climber's interview

Question	Transcript of SC1 interview	Transcript of SC2 interview	Transcript of SC3 interview
Does this information relate to your strategy?	Yes, sis, there are three angles, then the DAC angle in the ADC triangle, which means the DAC angle is equal to 60º. Next, the supplementary angle is equal to 180º, so I subtract the angle 180º equals 60º equal to 120º ... I divided it by 2 because there are only 2 unknown corners left. Wait a minute... oh I added ∠BDA and ∠DAB together and the result was 150º. After that, I searched ∠α using the supplementary angle for this angle (pointing at an angle of 40º), 180º minus 40º equals 120º.	Yes, sis, I'll draw (draw two corners cut by a transverse line). This is Sis, for example, ∠DBA was in the same position as ∠B1. So, ∠B1 it's equal to 40º, if ∠B1 it's 40º, it means ∠B2 it's equal to 140º because it's straight. ∠B2 it's equal to ∠A2, because, the faces are the same, so it's equal to 120º. Then ∠A2 it's equal to ∠A4, and it's also straightened out, so it's ∠A4 equal to 40º. Find ∠CAB using the same method as the properties of the angle earlier, it is ∠CAB equal to ∠DCA, ∠DCA = 60°. So, ∠CAB is also equal to 60º. After looking for the angle earlier, I immediately looked for ∠α. ∠α equals 180º minus 40º equals 140º. Lastly, ∠BDA added ∠DAB together equals 140º.	Yes, sis, I'm looking for ∠BDA, it's in the ABD triangle, then in this triangle, all the angles are known ∠DAB, ∠ABD except for the ∠BDA. So, I use the formula for the sum of the angles of a triangle. So, there's a relation. After searching ∠BDA, I entered the ∠DAC and ∠CAB into ∠DAB. Next, add up the ∠BDA and ∠DAB. After that I'm looking for ∠α, 180º minus 40º equals 140º, I'm sorry Sis, this is the correct one. After that, compare the results of the sum of the angles with ∠α.
What conclusions can you draw?	∠α bigger than ∠BDA + ∠DAB … uh small sis… it means Andi is right	In my opinion, Cici's opinion is correct because the sum of ∠DAB and ∠BDA is equal to ∠α. uh sorry wrong Sis … Beni I mean.	Beni's opinion is correct, not Andi Sis because ∠α equal to ∠BDA + ∠DAB. So, Beni's opinion is correct.
Are you sure about your answer?	Already Sir...	Already	Yes sir
Explain why do you believe in the results you found?	because the method I use is correct	I have checked everything. *Insha Allah*, the method is by the concept given by my teacher	Because earlier I counted again Sis and I checked the methods is correct.

According to the tables above, at the stage of confidence in mathematics, SC1, SC2, and SC3 were aware of using several mathematical concepts in solving problems. SC1 knew the

advantages of the chosen concept so she was confident about the chosen strategy but had a less effective strategy. While SC2 and SC3 knew the advantages of the chosen concept so they felt confident about the chosen strategy and had an effective strategy. On the indicator of confidence in mathematics, SC1 was in a good category, meanwhile SC2 and SC3 had a very good category. Whereas WoU of SC1was in enough category because the SC1 could explain the problem as a whole, and explain concepts well, but was not precise in choosing certain concepts and was unable to make connections between concepts. WoU of SC2 and SC3 were in the very good category because they could explain the problem as a whole and the strategy well, and the concepts used were appropriate. Based on the description and data analysis of SC1, SC2, and SC3 in the questions, the WoT of SC1, SC2, and SC3 in solving line and angle questions could be seen in Table 8, while the WoU can be seen in Table 9 below:

Table 8. Ways of thinking (WoT) subject climber conclusion

WoT Indicator	SC1	SC2	SC3	Conclusion
Problem solving approach	Enough	Good	Good	Good
Proof Scheme	Beyond belief	Empirical	Empirical	Empirical
Belief in mathematics	Good	Very good	Good	Good

Table 9. Ways of understanding (WoU) subject climber conclusion

WoU Indicator	SC1	SC2	SC3	Conclusion
Understanding problems, choosing concepts/algorithms, explaining concepts and linking concepts in solving problems	Enough	Very good	Very good	Very good

The three climber students had high determination in which they understood the problem well, could mention written and unwritten information on questions, plan strategies properly and precisely, and solve problems well even though they only employ one solution strategy. In line with the research of Yani et al., (2016), she states that climber students have assimilation thinking processes that occur when planning problems and implementing problems, and can use cognitive schemes well in solving problems.

Then, the approaches used by climber students were vary and the correct problem-solving was obtained, this showed that in solving problems, climber students tried to do it to the fullest and best. This is in line with the study conducted by Chabibah et al., (2019) who state that climber students can carry out all stages of the thinking process in solving mathematical problems with various problem-solving approaches. Climber students with the highest AQ level will always try to solve every problem well (Husain et al., 2022). Climbers students do not simply believe the truth of the results they get before they student does a re-examination (Widyastuti, 2015). This shows that climber students have an awareness of using the concept and know the effectiveness and advantages of the chosen concept.

WoT and WoU of campers' students

SP1, SP2, and SP3 tended to only write one problem-solving strategy with different problem-solving approaches. In the problem-solving approach stage, SP1, SP2, and SP3 employed the concept of adding and subtracting angles, as shown in Figure 4.

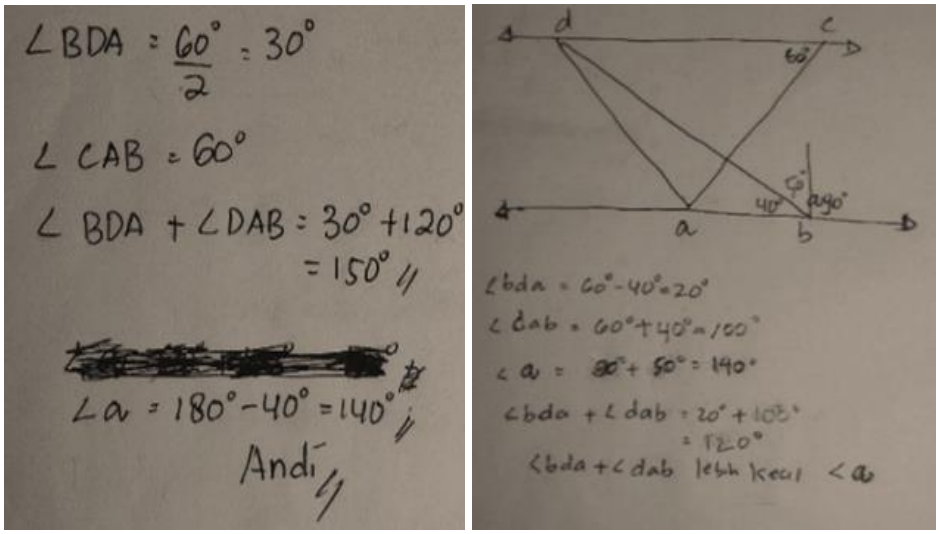


Figure 4. The work's results of SP1 campers (left image) and SP2 campers (right image)

At the proof scheme stage, SP1 and SP2 did not write down information either in the form of pictures or writing. When planning, SP1 started by looking for ∠BDA, ∠CAB, and ∠α used the concept of division and sum of angles in solving problems, SP2 and SP3 used the concept of sum and subtracting angles in solving problems. At the strategy selection stage, SP1, SP2, and SP3 employed their strategies to find ∠BDA, ∠CAB, and ∠α. SP1 and SP2 admitted that they got the strategy from friends without understanding the meaning of the concept used (authority scheme), while SP3 believed in a concept based on what the subject usually did when solving problems without understanding the meaning of a concept (ritual scheme). So, the strategies of SP1, SP2, and SP3 are not quite right, as shown in Figure 5.

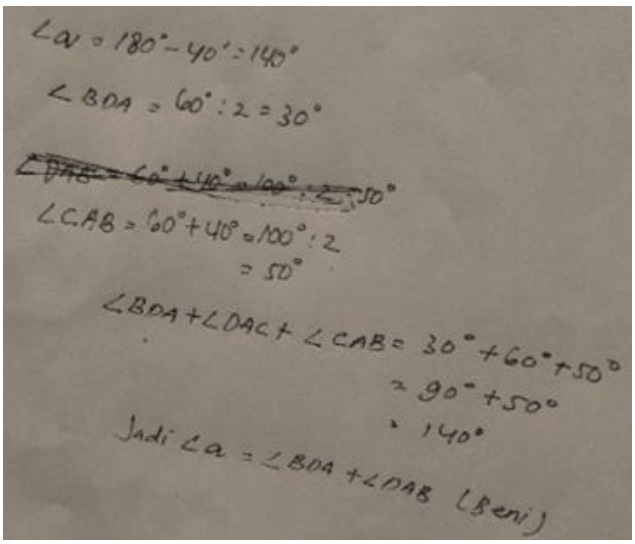


Figure 5. The work' result of SP3 camper

This could be seen in the excerpts of the interview results in Table 10. At the answer-finding stage, SP1 concluded that Andi's opinion was correct, and SP2 concluded that ∠BDA, ∠CAB was smaller than ∠α, in this case, Andi's opinion was correct. While SP3 concluded that Beni's opinion was correct. SP1, SP2, and SP3 believed that their answers were correct. SP1, SP2, and SP3 subjects re-examined the strategies that had been worked out. SP1 could solve the problem

in 44 minutes, SP2 could complete it in 39 minutes, and SP3 finished in 20 minutes. So, it was concluded that at the stage of the proof scheme, SP1, SP2, and SP3 were included in the way of thinking beyond belief.

Table 10. Transcript of interview with subject campers

Question	Transcript of SP1 interview	Transcript of SP2 interview	Transcript of SP3 interview
Describe in detail how you tackled this problem?	At first, I first divided 60º by 2 to find ∠BDA. Then I find the angle ∠CAB, ∠CAB equal to 60º. Then ∠BDA I add ∠DAB it equal to 150º. Then I find ∠α, I subtract the supplementary angle 180º with 40º equals 140º	I'm looking for ∠BDA, BDA equals 60º minus 40º equals 20º. Then search ∠DAB, ∠DAB equals 60º plus 40º equals 100º. Next, search ∠α, ∠α equals 90º plus 50º equals 140º. ∠BDA is equal to ∠DAB but is not yet added together... ∠BDA plus ∠DAB is equal to 20º plus 100º equals 120º so it ∠α is greater than ∠BDA + ∠DAB.	First of all, I'm looking for ∠α Sis, by subtracting the angles 180º and 40º. Then I try to find ∠BDA, by dividing the 60º by 2. After that, I'm looking for ∠CAB by adding the 60º and 40º, then I divide by 2 equals 50 degrees. After that, I added ∠BDA and ∠DAB, and the result is 140 degrees. So, Beni's opinion is correct.
Ok, where did you get the idea to search? Try to explain!∠BDA	Me, at first, I was confused and then when I saw the picture... it turned out ∠BDA that this was half from ∠ADC. So, I divided by 2 equal 60º … It was shared by my friend Sis, so I couldn't answer this one.	From me... earlier I just tried to do as much as I could Sis, I didn't understand a bit... because my teacher only explained briefly	Then I tried to find ∠BDA by dividing the 60° angle by 2. I can see from your picture that the DB line cuts the ADC angle in half.
How did you know that triangle ADC is equilateral?	From the question, Sis. It is known that the line CD = DA = AC	Already	Yes sis
OK, based on the strategy you explained earlier, what conclusions can you draw?	Andi	∠BDA + ∠DAB is smaller to ∠α	Because ∠α it is equal to ∠BDA + ∠DAB. So, I think Beni's opinion is correct.
After listening to your explanation, are you sure about your answer?	Yes	Not sure	Yes
Explain why you believe in the results you found?	Checked again Sis, the result is equal to in the picture	-	I already checked

At the stage of confidence in mathematics, SP1, SP2, and SP3 were aware of using several mathematical concepts in solving problems. SP1, SP2, and SP3 knew the advantages of the chosen concept so they felt confident about the chosen strategy but had less effective strategy. On the indicator of confidence in mathematics, SP1 was in a good category, SP2 was in enough category, while SP3 was belong to good category as well. Whereas the students' WoU, SP1, SP2, and SP3 were in enough category because SP1 could explain the problem as a whole and explain concepts well, but was not precise in choosing certain concepts and was unable to link between concepts, while SP2 and SP3 could partially explain the problem. Based on the description and data analysis of SP1, SP2, and SP3 in the questions, the WoT of SP1, SP2, and SP3 in solving line and angle questions can be seen in Table 11, while the WoU can be seen in Table 12.

Table 11. Ways of thinking (WoT) subject campers conclusion

WoT Indicator	SP1	SP2	SP3	Conclusion
Problem solving approach	Enough	Enough	Enough	Enough
Proof Scheme	Beyond belief	Beyond belief	Beyond belief	Beyond belief
Belief in mathematics	Good	Good	Good	Good

Table 12. Ways of understanding (WoU) subject campers conclusion

WoU Indicator	SP1	SP2	SP3	Conclusion
Understanding problems, choosing concepts/algorithms, explaining concepts and linking concepts in solving problems	Enough	Less	Enough	Enough

The three campers' students had moderate determination in which they understood the problem sufficiently, could mention information in writing only and analyze some of the information well. Campers' students experienced difficulties in determining and using concepts in designing settlement strategies, so they were not able to solve problems properly and appropriately. This is in accordance with the research by Nurhasanah, (2019) that campers students tend to have accommodation and semi-conceptual thinking processes. They have not been able to use cognitive schemas properly in solving problems. Campers students can carry out the stages of the thinking process up to the stage of implementing strategies for solving math problems with limited abilities (Chabibah et al., 2019). This shows that campers students do not have an awareness of using the concept and know the effectiveness of the chosen concept.

WoT and WoU of quitters' students

SQ1 and SQ2 tended to only write one problem-solving strategy with different problem-solving approaches, but they didn't complete the answer, as shown in Figure 6.

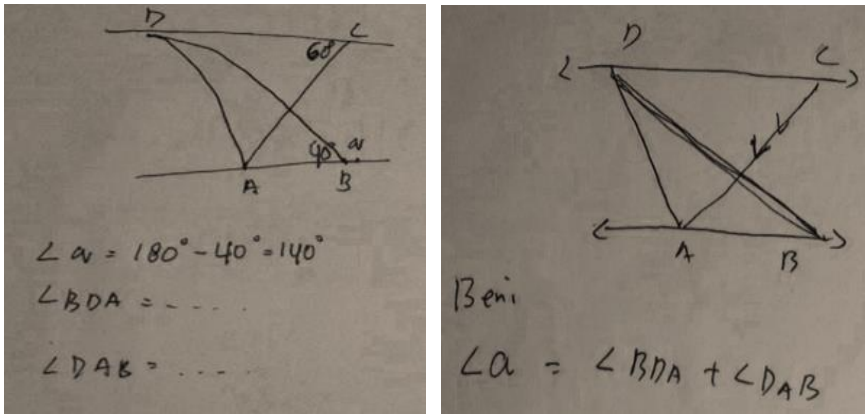


Figure 6. Student work results in quitters SQ1 (left image) and SQ2 (right image)

At the proof scheme stage, SQ1 and SQ2 did not write down information either in the form of pictures or writing. When planning, SQ1 started by writing down several angles to look for; ∠α, ∠BDA, and ∠DAB, while SQ2 started by looking for arcs. At the stage of choosing a strategy, SQ1 and SQ2 used their strategy to find ∠α. SQ1 and SQ2 subjects didn't know what concept used for the next plan. The subjects admitted that they got the plan from a friend (authority scheme). So, the SQ1 and SQ2 subject strategies were not quite right.

This could be seen in the excerpts from the interview results in Table 13. At the stage of finding answers, SQ1 had no conclusions, while SQ2 concluded that Beni's opinion was correct. At the checking stage, SQ2 re-checked the results of the answers he obtained by measuring again, but when he re-examined, the results obtained were different so the SQ2 subject was unsure of the results of the answers. Regarding to the duration, SQ1 could solve the problem in 49 minutes, while SQ2 was in 12 minutes. So, at the stage of the proof scheme, SQ1 and SQ2 were included in the way of thinking beyond belief.

Table 13. Transcript of interview with subject quitters

Question	SQ1 interview transcript	SQ2 interview transcript
Describe in detail how you tackled this problem?	I don't know sis; I can just look for ∠α it. Difficult Sis.	Earlier I wanted to use a ruler arc Sis... because earlier there was no math class and my friends didn't bring it either, so I looked for something else and I found it with a wire. I made this wire earlier and then I pasted it like a corner. When it's finished, I slide it to the BAD corner, then I slide it to ADB.
Where did you get this idea from?	-	From the teacher…. He... it's not right Sis, this is from me... the teacher measured it using a ruler arc, instead of a wire but there wasn't an arc before... so I took the initiative to use a wire.
Did you not use the information you know to solve this problem?	-	No Sis, I don't understand, it's better to use the tool right away
Is there any other way besides the way you do?	-	There is, use the formula, but I can't memorize it... it's hard...

OK, so you're also having trouble finding ∠DBA and ∠DAB? Why?	Yes, Sis, I don't understand the material and I don't know how	-
OK, based on the strategy you explained earlier, what conclusions can you draw?	No sis	Beni
After listening to your explanation, are you sure about your answer?	-	Not sure sis.
Why?	-	I checked again...the answers have changed but it seems that the answer is that.

At the stage of confidence in mathematics, SQ1 and SQ2 were aware of using several mathematical concepts in solving problems. SQ1 and SQ2 did not know the benefits of the chosen concept and had fewer effective strategies. This happened because the results obtained were inaccurate even though the subject could complete the test. On the indicators of confidence in mathematics, SQ1 and SQ2 were belong to less category. Whereas WoU of SQ1 and SQ2 were in the less category because they could not explain the problem correctly, explain the concepts verbally and choose concepts correctly, and they could not relate concepts in solving problems logically. So, WoT and WoU of climbers' students were better than camper students and quitter students. Based on the description and data analysis of subjects SQ1, and SQ2 in the questions, the WoT of subjects SQ1, and SQ2 in solving line and angle questions can be seen in Table 14, while the WoU can be seen in Table 15 below:

Table 14. Ways of thinking (WoT) subject quitters conclusion

WoT Indicator	SQ1	SQ2	Conclusion
Problem solving approach	Enough	Enough	Enough
Proof Scheme	Beyond belief	Beyond belief	Beyond belief
Belief in mathematics	Less	Less	Less

Table 15. Ways of understanding (WoU) subject quitters conclusion

WoU Indicator	SQ1	SQ2	Conclusion
Understanding problems, choosing concepts/algorithms, explaining concepts and linking concepts in solving problems	Less	Less	Less

The two quitters' students had low determination and they were able to understand the problem properly. Quitters' students could only mention part of the information in writing and were not able to analyze the information properly. Quitters' students experienced difficulties in determining settlement strategies so the final results obtained were not correct. This is in line with research by Kusumawardani (2018) which states that quitter students have not been able to use cognitive schemas properly in solving problems. Quitter students are only able to focus on results and are unable to understand the meaning of the resulting concepts and processes resulting in the wrong answers. The two quitters' students also did not validate the results of their answers and felt doubtful about the results obtained. This is in line with research by Chabibah et al. (2019) which states that quitter students are only able to carry out the stages of the thought process in reading and planning without solving the problem properly. This shows

that quitter students do not have awareness of using the chosen concept and do not know how to do it.

The characteristics of WoT and WoU are interconnected. The WoU that is incorrect and incomplete results in a WoT that is illogical or wrong, while a good WoU will produce a WoT that is systematic, logical, and effective (Mefiana & Herman, 2023; Nurhasanah et al., 2021). The implication of WoT and WoU in education is that when teachers know the students' thinking processes in both WoT and WoU. Therefore, teachers could design an appropriate learning that considers the characteristics of their students' WoT and WoU. Apart from that, the difference between students' WoT and WoU influences students' mathematical abilities and differences in understanding a concept (Samosir & Herman, 2023). Therefore, to support students' WoT and WoU, teachers must familiarize students with solving non-routine problems in various mathematics learning contexts (Aiyub, 2023).

Conclusion

Based on the results of the research that has been done, it could be concluded that regarding to the WoT of climbers' students, they tended to have only one strategy that led to the correct solution, had an empirical way of thinking, and had very good self-confidence in mathematical concepts in terms of in problem-solving on lines and angles. While the WoU were very good. Furthermore, the WoT of campers' students in solving problems on lines and angles tended to have only one strategy that led to wrong solutions, the way of thinking used by them was beyond belief, and they had good confidence in mathematical concepts. Whereas WoU were in enough category. The last but not least, the WoT of quitters' students in solving problems on lines and angles tended to have only one strategy that led to the wrong solution, the way of thinking used by them was beyond belief, and they had less belief about mathematical concepts. Meanwhile, the WoU were less category. In brief, WoT and WoU of climber students were better than the camper and quitter students.

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