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Analysis of junior high school students' algebraic reasoning abilities in solving problems viewed from the perspective of Adversity Quotient (AQ)

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Abstract

This study is motivated by the relatively low algebraic abilities of Indonesian students, particularly in transforming contextual problems into formal mathematical representations, as highlighted in recent mathematics education findings . Beyond cognitive factors, students' success in overcoming such difficulties is strongly influenced by their mental resilience, known as Adversity Quotient (AQ). Therefore, this research aims to describe junior high school students' algebraic reasoning abilities in problem-solving from the perspective of AQ. A descriptive qualitative approach was employed, involving three ninth-grade students representing each AQ category: climber, camper, and quitter. The subjects were selected through stratified purposive sampling based on the results of the Adversity Response Profile (ARP) questionnaire. Data were collected using written algebraic reasoning tasks integrating social arithmetic and two-variable linear inequalities, as well as in-depth semi-structured interviews. Data analysis followed the Miles, Huberman, and Saldaña model, including data condensation, data display, and conclusion drawing. The findings indicate significant differences in algebraic reasoning across AQ types. Climber students successfully demonstrated all stages of algebraic reasoning—pattern seeking, pattern recognition, and generalization—supported by persistence and adaptive strategies. Camper students showed adequate ability in identifying and recognizing patterns but were limited in formal representation and generalization. In contrast, quitter students experienced substantial difficulties at almost all stages, reflecting low persistence. These results confirm that AQ plays a crucial role in shaping students' algebraic reasoning and problem-solving performance.

***Keywords**: Algebraic Reasoning, Adversity Quotient, Problem Solving, Junior High School Students.*

1. Introduction

According to the 2022 Programme for International Student Assessment (PISA), Indonesian students' mathematics skills remain low, especially in reasoning [1]. This is a crucial problem because reasoning is fundamental to understanding mathematical concepts and problem-solving [2,3]. Specifically, algebraic reasoning is critical because it helps students understand concepts through clear calculation steps, enabling them to apply procedures to solve problems [4,5]. However, in reality, many students still experience difficulties in solving problems due to their weak algebraic reasoning skills [6,7]. The real challenge is not basic arithmetic, but rather the process of modeling real situations to formal terms [8]. Students often fail to translate unknown variables into symbols and build correct equations based on those relationships [9,10]. The researcher also has experience teaching junior high school students who struggled to transform real contexts into mathematical forms and identify relationships between variables.

This issue must be addressed, as the ability to discover relationships and generalize them into formal mathematical expressions is essential for algebraic reasoning [11,12,13]. Furthermore, students' success in overcoming these challenges depends on their Adversity Quotient (AQ), which determines their persistence in turning obstacles into opportunities [14]. Although previous studies have examined algebraic reasoning in terms of cognitive style [15], open-ended questions in social arithmetic [16], and reasoning levels in PISA model questions, there are still gaps in the research. No research has used instruments in the form of problems that combine social arithmetic and two-variable linear inequalities, and has analyzed them by integrating Polya's stages of algebraic reasoning indicators. In fact, the combination of the contexts of these two materials is ideal for analyzing algebraic reasoning skills more comprehensively, as students are required to create models and make logical decisions based on the relationships among variables [17].

This research is essential because the lack of attention to the profile of algebraic reasoning based on persistence (AQ) level affects the effectiveness of learning strategies. By understanding students' characteristics of algebraic reasoning, teachers can design more appropriate and targeted learning strategies. Therefore, this study aims to describe junior high school students' algebraic reasoning abilities in problem-solving using the Adversity Quotient (AQ) and to provide input for the development of learning strategies that can improve algebraic reasoning abilities more effectively and evenly for all students.

Several researchers have studied students' algebraic reasoning profiles across various review variables. Ilmi and Abdussakir (2024) examined the level of algebraic reasoning in PISA model questions using the Adversity Quotient (AQ) [18]. They found that climber-type students achieved a complex generalization level, while quitter-type students had only a concrete understanding and often misunderstood the questions. Another study by Dewi and Setianingsih (2025) explored students' algebraic reasoning abilities in social arithmetic using open-ended questions, and the results showed that AQ type strongly influenced students' ability to find patterns and formulate general rules [16]. In contrast, quieter students did not complete any of the reasoning activities. Meanwhile, in the context of two-variable linear equation systems, Setyaningrum and Rahaju (2021) described students' algebraic reasoning [15]. Still, they reviewed it from a cognitive style perspective (visualizers and verbalizers), rather than from an Adversity Quotient (AQ) perspective.

Although these studies provide an overview of the importance of cognitive and non-cognitive factors in students' algebraic reasoning, there are still gaps. Ilmi and Abdussakir's research emphasises the use of Ake et al.'s indicators to determine reasoning levels, but it does not describe students' thinking processes in detail at each step of the problem-solving process. In addition, Dewi and Setianingsih's research covers only social arithmetic material and does not include more abstract topics, such as two-variable linear inequalities. To date, no research has integrated Herbert and Brown's algebraic reasoning indicators with Polya's problem-solving stages in the context of combining social arithmetic and two-variable linear inequality material.

Therefore, this study aims to fill this gap by providing a more comprehensive analysis of students' algebraic reasoning abilities across various types of AQ when solving problems that combine these two materials.

The algebraic reasoning of junior high school students in solving problems is analyzed in this study using the Adversity Quotient (AQ). The framework relies on several core concepts. First, Herbert & Brown (1997) provide the stages of algebraic reasoning, pattern seeking, recognition, and generalization [19]. This model was selected for its ability to describe the transition from concrete to abstract thought. Second, Polya's (1973) four-step method is utilised to observe problem-solving processes [20] Finally, Stoltz's (2000) AQ theory classifies student resilience as climber, camper, or quitter [14]. By integrating these theories, the study examines how different persistence types (AQ) affect algebraic reasoning at each stage of problem-solving.

Algebraic reasoning is characterized as a thinking process wherein pattern are identified, relationships among variables are understood, and generalizations are established through mathematical symbols [21,13,5]. Unlike arithmetic, where the focus is placed on number calculation, emphasis is laid by algebraic reasoning on the discovery of general structures and functional relationships that are applied broadly [17]. In this study, algebraic reasoning was analyzed using the framework developed by Herbert and Brown (1997), which is comprising three main stages [19]. The first stage is pattern-seeking, a stage where information is collected and regularities within the available data are identified. The second stage is pattern recognition, the process of testing the validity of the patterns is tested found to ensure correctness. The last is generalization, a stage where general rules are formulated in mathematical model. This ability to generalize is essential because it demonstrated that thinking is not limited to specific examples, but rather that procedure is understood. It has been shown by some researches that difficulties are often experienced by junior high school students during the generalization stage, particularly when contextual situations are transformed into formal algebraic forms [7,8]. These challenges are associated not merely with arithmetic operations, but primarily with the capacity for relationships between variables to be modeled and for appropriate systems of equations to be constructed [9].

To examine how algebraic reasoning is demonstrated in authentic problem-solving situations, this research adopts George Polya's problem-solving framework. Problem-solving, as described by Polya (1973), is an effort to overcome a difficulty to reach a goal that cannot be achieved immediately [20]. His framework is organized to four stages, (1) Understanding the problem, where students sort out what information is given and uknown, (2) Planning a solution, which deciding strategy or constructing a mathematical model, (3) Executing the plan through the chosen steps and calculations, and (4) Reflecting on the solution to check again make sure the answer is correct. Polya's framework has been used in many mathematics education research to analyze students' thinking [22]. When linked to algebraic reasoning, these stages can be matched with indicators such as finding patterns, checking the relation between variables, and making generalizations [15]. This match is considered important because algebraic reasoning typically arises when students encounter problems that require symbolic ideas and generalization [5]. In this research, indicators of algebraic reasoning are integrated at every stage of Polya's model to describe students' thinking processes.

Adversity Quotient (AQ) is defined as a person's ability to continue trying, deal with difficulties, and recover after facing obstacles [14]. Unlike IQ, which is used to measure intellectual ability, or EQ, which is used to measure emotional intelligence, AQ is focused on mental resilience when challenges are encountered. Stoltz (2000) explained that AQ consists of four parts known as CO2RE: Control (the extent to which difficult situations can be managed), Origin and Ownership (how causes of problems are identified and responsibility is taken), Reach (how the impact of difficulties is limited), and Endurance (the belief that problems will not last forever) [14]. Based on these levels, individuals are classified into three groups: climber, who are seen as persistent until tasks are finished, camper, who tend to stop after reaching a temporary result, and quitter, a person who gives up easily. In mathematics learning, it has been shown that AQ makes a significant contribution to how well students handle challenging tasks [23,24].

Although algebraic reasoning is categorized as a cognitive skill and AQ as a non-cognitive factor, the two are viewed as closely connected in problem-solving situations. Algebraic reasoning is considered to require continuous mental effort, especially when contextual situations have to be translated into symbolic representations and when generalizations need to be formed [5]. This is where AQ acts as a mediator, determining how persistently students maintain their cognitive processes [14]. Several studies show variations in algebraic reasoning abilities based on AQ types. Sanit et al. (2019) found that climber students performed algebraic reasoning more fully during generalization activities, whereas quitter students tended to be unable to complete all reasoning activities [25]. Ilmi & Abdussakir (2024) showed that climber students achieved a higher level of algebraic reasoning when solving PISA model questions than camper and quitter students [18]. Dewi & Setianingsih (2025) found that climber and camper students were able to complete all algebraic reasoning indicators in open-ended questions, while quitter students did not complete any activities [16]. However, these studies have not used a problem context that integrates social arithmetic and two-variable linear inequalities with an analytical framework that combines Herbert & Brown (1997) and Polya (1973), leaving a research gap that needs to be filled [19,20].

2. Research Method

A qualitative, descriptive research approach is used in this study. This approach was chosen because the study aimed to describe and explore in depth the meaning of students' algebraic reasoning in problem-solving. The study was conducted at a junior high school in Surabaya with ninth-grade students in the even semester of the 2025/2026 academic year who had studied social arithmetic and two-variable linear inequalities. The research subjects were determined using stratified purposive sampling. The subject selection procedure began with the determination of one class based on teacher recommendations. Then, all students in that class were given an Adversity Response Profile (ARP) questionnaire to group them into three AQ categories based on their scores. The criteria for determining AQ categories were based on the guidelines proposed by Stoltz (2000), as shown in Table 1. At each AQ group, one student was chosen as a research participant, and the selection was carried out by considering gender similarity and strong communication skills so that detailed information could be obtained during the interview [14]. Different levels of mathematical ability were also included in this study to ensure that a more complete picture of a student's algebraic reasoning profiles could be captured across various levels of problem-solving skill.

Table 1. Types of AQ based on ARP questionnaire scores

ARP Questionnaire Scores	AQ Type
ARP Score ≤ 95	*Quitter* (Low AQ)
$96 \leq$ ARP Score ≤ 165	*Camper* (Medium AQ)
$166 \leq$ ARP Score ≤ 200	*Climber* (High AQ)

The researcher served as the primary instrument in this study, while the supporting instruments consisted of the ARP questionnaire adapted from Stoltz (2000), a set of algebraic reasoning tasks, and interview guidelines [14]. The ARP questionnaire comprises 20 statements covering the dimensions of Control, Origin-Ownership, Reach, and Endurance. The algebra reasoning tasks contain contextual problems that combine social arithmetic content with two-variable linear inequalities, designed to measure indicators of algebraic reasoning integrated with Polya's problem-solving stages, as shown in Figure 1 [20].

Data collection involved administering written tests to selected subjects, followed by in-depth semi-structured interviews to explore thought processes not evident in written responses. Data validity was ensured through triangulation of techniques, which compares the results of written tests with those of interviews.

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Data analysis techniques refer to the model by Miles et al. (2014), which includes data condensation, data display, and conclusion [26].

Mr. Faiz is a school supplies seller. He usually buys from three suppliers at different prices. The three suppliers are Cahaya Distributor, Jaya Distributor, and Sinar Distributor. The following table shows the prices of bags and shoes per dozen from each supplier in a normal month.

Distributor	Bag Price (per dozen)	Shoe Price (per dozen)
Cahaya Distibutor	Rp2.220.000,00	Rp1.740.000
Jaya Distributor	Rp2.040.000,00	Rp1.920.000
Sinar Distributor	Rp2.280.000,00	Rp1.860.000

However, as the new school year approached, the prices of bags and shoes from the three distributors increased due to surging market demand. The following is the percentage increase in the price of each item.

Distributor	Percentage Increase Bag Price (per dozen)	Percentage Increase in Shoe Prices (per dozen)
Cahaya Distibutor	25%	20%
Jaya Distributor	15%	10%
Sinar Distributor	10%	20%

It turns out that Mr. Faiz ran out of stock at the start of the new school year. He will buy new stock with a budget of Rp15,000,000.00 to buy bags and shoes. If Mr. Faiz wants to buy 15 dozen bags and 1 dozen shoes to meet market demand, can his wish come true?

1. If possible, explain your reasons!
2. If not, help Mr. Faiz determine the maximum number of dozen bags he can buy, by maximizing the use of the available budget and the number of bags in stock, while also having to buy 1 dozen shoes! Also explain your reasons for choosing the distributor where to buy the bags and shoes.
3. If Mr. Faiz will take a 10% profit on each item, determine the selling price of each bag and pair of shoes.

Figure 1. Algebraic reasoning task

At this stage, the researcher sorts the raw data obtained from written tests and interview transcripts. Condensation is achieved by coding each data segment. Coding is based on students' algebraic reasoning activities, using the adaptation indicators of Herbert & Brown (1997) as presented in Table 2 [19].

Table 2. Indicators of algebraic reasoning ability

Indicator	Algebraic reasoning activities	Code indicator
Pattern Seeking	Collect information from a problem in the form of words, symbols, or pictures.	S1
	Represent known elements in the form of tables or symbols.	S2
	Find the elements that make up a pattern	S3
Pattern Recognition	Make a guess regarding the pattern of the relationship between two quantities.	R1
	Test the correctness of the obtained pattern.	R2
Generalization	Create general rules in mathematical form that are used to solve problems.	G

Next, to maintain consistency and ease of tracking interview data, the researcher created specific codes for each question and subject response. This coding distinguishes between the researcher and the subjects based on AQ type (*climber*, *camper*, *quitter*), as presented in Table 3.

Table 3. Interview transcript code

Code	Explanation
P.CL.n	The researcher's question to the n-th subject of CL.
P.CA.n	The researcher's question to the n-th subject of CA.
P.QT.n	The researcher's question to the n-th subject of QT.
S.CL.n	CL research subject's answer to the researcher's n-th question.
S.CA.n	CA research subject's answer to the researcher's n-th question.
S.QT.n	QT research subject's answer to the researcher's n-th question

The condensed and coded data are organized in a narrative form. The researcher presents the findings for each subject type. Each presentation explains how the subject showed algebraic reasoning at every stage of Polya's problem-solving process. The data are also supported by direct interview excerpts and samples of students' written work, providing a clearer, evidence-based picture of their algebraic reasoning [20].

The final stage is carried out by interpreting the data that has been presented. The researcher looks for patterns, differences, and consistency in the thinking processes shown by each AQ type. Conclusions are drawn from the written tasks and interviews, using triangulation to describe students' algebraic reasoning skills for each Adversity Quotient type. These conclusions represent the main goal of this research, which is to explain how climber, camper, and quitter students demonstrate algebraic reasoning.

3. Result and Disscusion

Result

Data collection was carried out in classes IXA and IXB at SMP Labschool 2 UNESA in Surabaya, with a total of 25 male students. The ARP questionnaire was given to all 25 students, and the results showed that there were 3 climbers, 19 campers, and 3 quitters, each with different levels of mathematical ability. Then, one student from each category was selected based on their communication skills.

The results of the written answers and SCL interviews are presented in Figures 2 and 3.

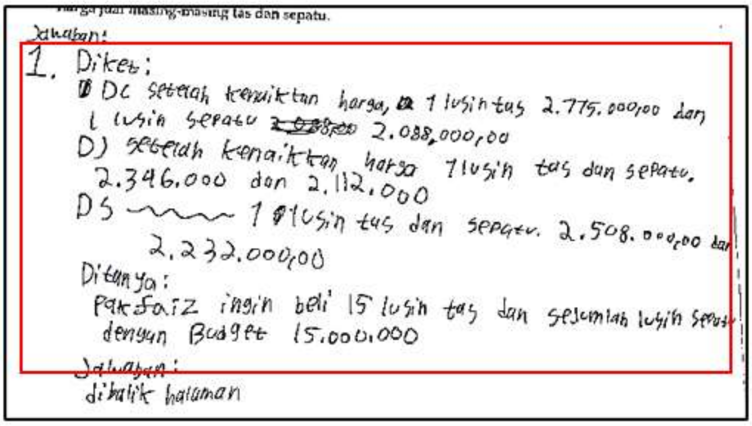

Figure 2. Activities of gathering information and discovering the elements that make up patterns

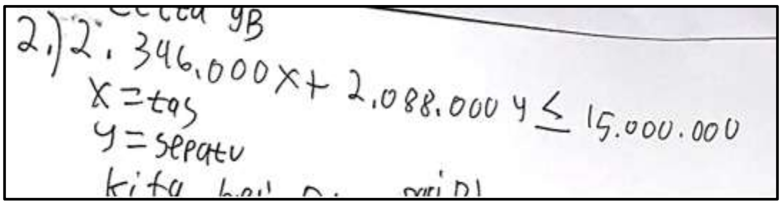

Figure 3. Activities for representing situations in mathematical form

P.CL.01 : *"What information did you get after reading this quiestion?"*

S.CL.01 : *"First, the price of dozen bags and shoes, and the price increase for each dozen items as a percentage at the start of the new school year. After that, Mr. Faiz had Rp.15.000.000...The quoestion is whether Mr. Faiz's wish will come true or not... "***(S1)**

P.CL.02 : *"What steps did you take?"*

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S.CL.02 : *"Calculated the price of feach item after the increase...I looked for cheap bags and shoes, then I used the inequality formula."***(S3)**

P.CL.03 : *"Why did you use an inequality?"*

S.CL.03 : *"At first, I thought it was an equation, but when I tried it, it turned out it couldn't possibly cost Rp.15.000.000,,,So I changed it to an inequality"* **(S2)**

Based on the results of written responses and interviews, SCL can gather complete information about the problem (S1), represent it as a two-variable linear inequality (S2), and identify pattern components by calculating prices after increases and comparing them across distributors (S3). The skill to adapt strategies from equation to inequalities shows strong flexibility in thinking. This is consistent with Herbert and Brown (1997), who explained that at pattern-seeking stage, students gather information and begin to recognize patterns [19]. SCL exhibits the characteristics of a climber who does not give up and enjoys challenges (Stoltz, 2000), as evidenced by not stopping at the first incorrect approach [14].

The results of the written answers and SCL interviews are presented in Figure 4.

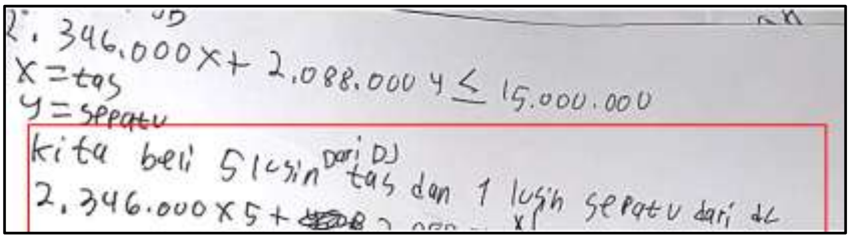


Figure 4. The activity of making assumptions

P.CL.04 : *"From the inequality formula you created, can you explain the relationship between x and y"*

S.CL.04 : *"Well, if x increases, y should decrease. If increase them both, it'll be exceed the budget."* **(R1)**

P.CL.05 : *"How do you determine the amount of x and y?"*

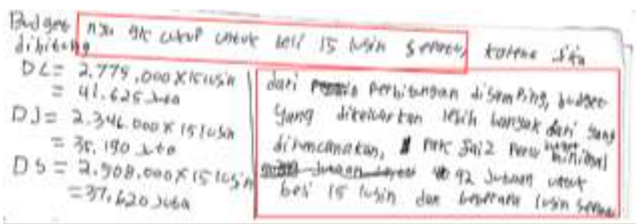
S.CL.05 : *"Just try a random number, sis. I initially used x=3 then x=6 then tried again with x=5 and the remaining budget couldn't be used to buy more bags."* **(R2)**

P.CL.06 : *"Why don't you choose the most expensive bag and shoes?"*

S.CL.06 : *"If there's a cheaper one, why not? logically, if people want to buy something, they'll definitely choose the cheaper one.."* **(R2)**

SCL reaches a correct conclusion by substituting x=15 and identifies the best solution through testing (G). The skill shown in forming a rule for determining the selling price indicates that the generalization stage has been achieved, as explained by Herbert and Brown (1997), where students develop general mathematical rules [19]. SCL not only completes the problem but also produces a rule that can be applied to other similar situations.

The results of the written answers and SCL interviews are presented in Figure 5.



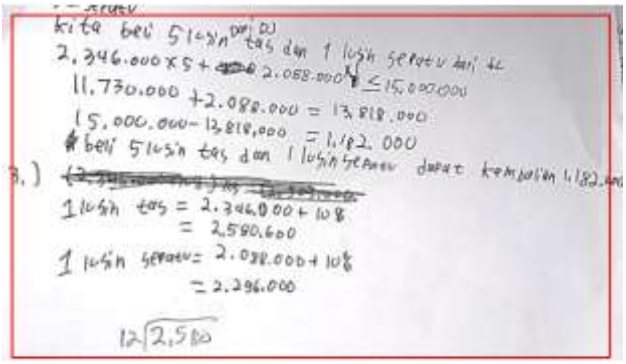


Figure 5. Activity using general rules

P.CL.07 : *"Did Mr. Faiz's wish to buy 15 dozen bags and one pair of shoes come true?"*

S.CL.07 : *"It didn't come true, sis. I entered x=15, but it turned out to be Rp15.000.000 more. So, Mr. Faiz bought 5 dozen bags and 1 dozen shoes with a remaining budget of Rp1.182.000."* **(G)**

P.CL.08 : *"How do you determine the selling price?"*

S.CL.08 : *"Multiply 10% by the price after the increase, then add the price after the increase. Since the question was per item, divide the result by 12, sis.."* **(G)**

SCL draws valid conclusions by substituting x = 15 and determines the optimal solution through testing (G). The ability to formulate rules for calculating selling prices indicates achievement of the generalization stage, as described by Herbert & Brown (1997), in which students create general rules in mathematical form. SCL not only solves the problem but also formulates rules that can be used for similar cases [19]. This demonstrates deep understanding, not just procedural knowledge.

The results of the SCA interview are as follows.

P.CA.01 : *"What information did you get from this problem?"*

S.CA.01 : *"The initial price of the bag and shoes, the percentage increase, Mr.Faiz's money is Rp15.000.000...Mr.Faiz wants to buy a dozen shoes and a dozen bags.."* **(S1)**

P.CA.02 : *"Why didn't you write down the information you asked here?"*

S.CA.02 : *"I'm too lazy for write so much."*

P.CA.03 : *"What was your first step?"*

S.CA.03 : *"To calculate the price of the item after the price increase, multiply the initial price by the percentage, then add the initial price. Then choose the cheaper one."* **(S3)**

P.CA.04 : *"Can you create a mathematical expression for Mr.Faiz's problem?"*

S.CA.04 : *"I have no idea sis"* **(S2)**

SCA can gather information (S1) and identify the elements that make up patterns (S3), but cannot create formal representations (S2). The inability to represent information in a mathematical model indicates a gap at the pattern-seeking stage, according to Herbert & Brown (1997) [19]. The attitude of 'not wanting to write too much' reflects a camper's tendency to be easily satisfied with temporary results (Stoltz, 2000) and to be unmotivated to create formal representations even when they understand the information [14]. This reflects a limited reach dimension, in which the camper confines their effort to a level that is comfortable for them.

The results of the written answers and SCA interviews are presented in Figure 6.

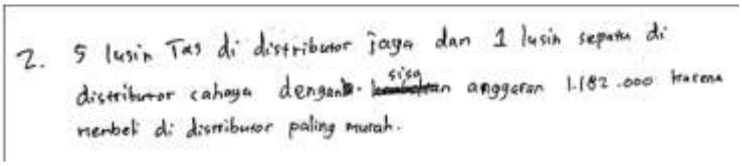
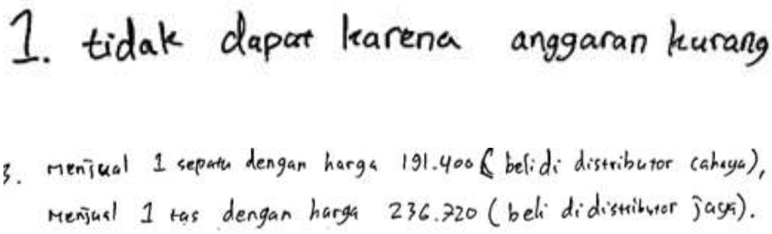

2. 5 lusin Tas di distributor Jaya dan 1 lusin sepatu di distributor cahaya dengan ~~kembalian~~ sisa anggaran 1.182.000 karena membeli di distributor paling murah.

Figure 6. Guessing activity

P.CA.06	:	*"Do you know the relationship between the number of bags and shoes you can buy and Mr.Faiz's budget?"*
S.CA.06	:	*"You know, the more bags you have, the fewer shoes you need to buy to avoid going over budget."* **(R1)**
P.CA.07	:	*"How you decide on these 5 dozen bags?"*
S.CA.07	:	*"Immediately tried on a dozen shoes from Cahaya Distributor and then divided the rest by the price of the bags from Jaya Distributor.So, based on the calculation, the remaining amount couldn't be used to buy anything else."* **(R2)**

SCA understands the relationship between variables (R1) and performs numerical verification (R2). Although it does not use a formal model, its conceptual understanding is quite good. SCA's strategy is efficient in specific cases but less generalizable because it does not rely on a mathematical model. This aligns with the pattern recognition stage described by Herbert & Brown (1997) but is not yet optimal [19]. The camper characteristics are evident from the 'fairly knowledgeable' understanding without developing it into a formal form, reflecting a tendency to remain in the comfort zone [14].

The results of the written answers and SCA interviews are presented in Figure 7.


1. tidak dapat karena anggaran kurang

3. menjual 1 sepatu dengan harga 191.400 (beli di distributor cahaya), menjual 1 tas dengan harga 236.720 (beli di distributor jaya).

Figure 7. Drawing conclusions activity

P.CA.05	:	*"Did Mr.Faiz's wish come true?"*
S.CA.05	:	*"No, the budget isn't enough."* **(G)**
P.CA.08	:	*"How do you determine the selling price?"*
S.CA.08	:	*"Multiply the price after the price increased by 10% then add the price after the price increase, and then divide by 12."* **(G)**

The SCA draws valid conclusions and explains procedures correctly (G). However, the SCA's generalisations are procedural for specific problems and have not reached the stage of creating general rules in the form of

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mathematics that can be used to solve similar problems [19]. This limitation is consistent with the characteristics of campers who are satisfied with ‘adequate’ achievements and do not develop a deeper understanding [14].

The results of the written answers and the SQT interview are presented as follows.

P.QT.01	:	*“What information did you get from this problem?”*
S.QT.01	:	*“Um..the prices of shoes and bags from three distributors, the price increase, Mr Faiz’s money Rp15.000.000 “* **(S1)**
P.QT.02	:	*“Are you sure that’s all the information you got?”*
S.QT.02	:	*“Wait sis...hmm..I think I’m sure, sis”* **(S1)**
P.QT.03	:	*“Why didn’t your write that?”*
S.QT.03	:	*“Not sure, sis”* **(S1)**
P.QT.04	:	*“What’s your first step?”*
S.QT.04	:	*“Confused, sis.”* **(S3)**
P.QT.05	:	*“Can you calculate the price after the increase?“*
S.QT.05	:	*“Mmm...I don’t have idea”* **(S3)**
P.QT.06	:	*“Can you make a mathematical representation of it?”*
S.QT.06	:	*“I can’t”* **(S2)**

SQT only mentions partial information with uncertainty (S1), cannot represent it in a formal form (S2), and cannot calculate the price after an increase (S3). The inability across all sub-indicators indicates that SQT does not carry out the pattern-seeking stage described by Herbert & Brown (1997) [19]. Statements like “Not sure” “confused,” “I don’t have idea” reflect the characteristics of a quitter who tends to give up easily and choose to avoid problems [14]. This indicates a very low control dimension where SQT feels unable to manage the situation.

The results of the written answers and SQT interviews are presented in Figure 8.

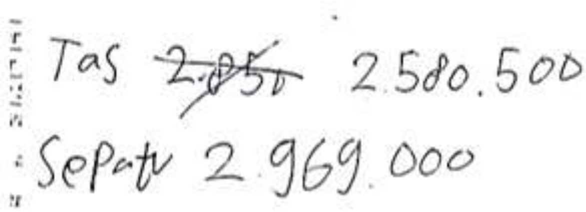

Figure 8. Activity of making predictions

P.QT.07	:	*“What’s the relationship between the initial and final tables in this question?”*
S.QT.07	:	*“What is it, sis? I don’t know”* **(R1)**
P.QT.08	:	*“How did you determine the number of bags, 5 dozen?”*
S.QT.08	:	*“Just guess, sis”* **(R2)**
P.QT.09	:	*“How did you that? because your answer is bags Rp2.580.500.”*

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S.QT.09 : *"Ask Tian, sis, hehehe...* **(R2)**

SQT is unable to make pattern assumptions (R1) and does not conduct testing; instead, it only guesses or asks other subjects (R2). This inability indicates that SQT does not go through the pattern recognition stage described by Herbert & Brown (1997) [19]. The strategy of 'guessing' and asking other subjects shows characteristics of a quitter who avoids difficulties [14]. A low origin-ownership dimension is evident from the absence of a sense of responsibility to find solutions independently.

The results of the written answers and SQT interviews are presented in Figure 9.

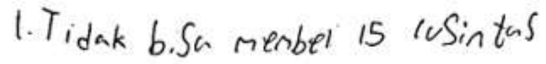

Figure 9. Drawing conclusions activity

P.QT.10 : *"Does that mean Mr.Faiz's wish came true?"*

S.QT.10 : *"No, sis"* **(G)**

P.QT.11 : *"Why?"*

S.QT.11 : *"Because Rp2.865.000 multiplied by 15 is Rp35.190.000, more than Rp15.000.000."* **(G)**

P.QT.12 : *"Which distributors do you use?"*

S.QT.12 : *"Which ones, sis...hmm..I don't know, sis."*

P.QT.13 : *"How do you determine the selling price per item?"*

S.QT.13 : *"I don't know, sis. I'm already dizzy, so I didn't answer."*

SQT tried to conclude but could not explain the basis and gave up with the reason 'already dizzy' (G). The inability to complete the selling price calculations indicates that SQT did not reach the generalization stage, as described by Herbert & Brown (1997) [19]. The statements' already dizzy' and 'already lazy' reflect a very low endurance dimension (Stoltz, 1997), where a quitter quickly gives up when facing difficulties and does not persist until the problem is solved [14].

Discussion

The research results show that students' algebraic reasoning abilities vary by Adversity Quotient (AQ) type. Climber students (SCL) can meet all indicators of algebraic reasoning, Camper students (SCL) can meet only several indicators, while Quitter students (SQT) experience difficulties with almost all indicators, which is consistent with previous findings showing differences in algebraic reasoning abilities based on AQ categories [16].

At the stage of understanding the problem, SCL can gather information, create mathematical representations, and find simple patterns, but cannot form formal mathematical models. SQT is still confused about understanding the information presented in the problem context. These findings align with Herbert & Brown's (1997) theory that pattern-seeking is an essential initial step in algebraic reasoning [19].

During the planning and execution stages, SCL can make assumptions about the relationships among variables and test them through several experiments. SCA can understand these relationships but cannot fully express them mathematically. SQT cannot make assumptions, it can only guess or ask friends for help. This indicates that differences in AQ affect students' perseverance when facing difficulties, as also reported in studies on algebraic thinking and AQ [27].

At the review stage, only SCL consistently verified their answers. SCA was checked to a limited extent, while SQT was not checked at all. This pattern reflects the characteristics of each AQ type. *Climber* students are persistent and able to control their thinking process. *Camper* students tend to stop once they feel it is 'enough.' Meanwhile, quitter students give up easily and see difficulties as major obstacles [28].

Overall, this study's results indicate that AQ influences students' algebraic reasoning abilities. These findings complement the framework of Herbert & Brown (1997) by integrating non-cognitive factors and reinforcing Polya's (1973) problem-solving model through aspects of student resilience [19,20]. On the other hand, the results of this study support Stoltz's (2000) assertion that AQ can be a factor affecting students' perseverance in completing tasks [14].

From a learning perspective, teachers can provide more challenging tasks for climber students, reinforce formal mathematical representations for camper students, and support quitter students through exercises designed to build mental resilience and targeted problem-solving strategies, allowing instructional approaches to be more precisely tailored to students' needs [16].

4. Conclusion

This study aims to describe the algebraic reasoning abilities of middle school students in solving problems from the perspective of Adversity Quotient (AQ). The results of this study indicate significant differences in algebraic reasoning abilities across students' AQ types. Climber students can perform all stages of algebraic reasoning fully, from pattern searching and pattern recognition to generalization, with high adaptability in strategy and perseverance. Camper students demonstrate a strong conceptual understanding of searching and pattern recognition. Still, they are unable to represent them in mathematical form or generalize them because they tend to be satisfied with a 'sufficient' understanding. Meanwhile, Quitter students face obstacles at almost every stage, marked by difficulties gathering information, finding patterns, and an unwillingness to engage in generalization activities. The results of this study confirm that the Adversity Quotient (AQ) plays an important role in determining the quality of students' algebraic reasoning. This demonstrates that learning should be differentiated according to students' AQ types, namely by providing more challenging problems for climber students, guiding camper students in strengthening their mathematical representations, and supporting quitter students to build resilience in problem-solving. The limitations of this study include the limited number of subjects and the specific problem context, so it is recommended that future research explore other algebraic topics, such as quadratic functions or sequences and series, with a more diverse group of subjects.

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