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Perseverance in mathematical reasoning of climber students solving linear equations in one variable

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Abstract

Research on mathematical reasoning has increasingly recognized perseverance as more than "not giving up"; it requires maintaining coherent reasoning when facing obstacles. However, micro-level analysis linking perseverance episodes to Adversity Quotient (AQ) dimensions remains limited, particularly in linear equation-in-one-variable contexts. The study used a descriptive qualitative approach, a single-case qualitative study that examined one climber-type student (selected via ARP questionnaire from 32 eighth graders) solving Linear Equation on Linear Variable (LEOV) tasks. Data included observations, semi-structured interviews, and written work, analyzed using Miles and Huberman's framework with source triangulation. The results show that Climber (AA) students illustrate strong Perseverance in Mathematical Reasoning (PiMR) through three integrated behaviors: (1) exploring multiple solution strategies and verifying results (Control–Endurance); (2) reflecting on errors and adapting approaches (Ownership–Reach); and (3) maintaining goal focus while revising strategies (Endurance–Control). These findings imply that mathematics instruction should systematically scaffold productive struggle, validation practices, and self-regulation to develop reasoning-specific perseverance, not merely task persistence.

Keywords: adversity quotient; climber; linear equation; mathematical reasoning; one variable; perceverance

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Introduction

Mathematical reasoning skills (interpreting situations, constructing arguments, checking the consistency of steps, and validating answers) are essential requirements in many education systems. This is because reasoning is directly related to mathematical literacy and readiness for advanced learning (Hadi, 2025; Napitupulu et al., 2016). However, international assessments indicate that many students still struggle with problems requiring multi-layered reasoning and resilience when solutions are not immediately apparent (Hadi, 2025; Martino, 2018; Säfström et al., 2024). In a global context, Indonesia's performance in PISA 2022, with an average score of 366 compared to the OECD average of 472, highlights persistent challenges in reasoning and meaningful problem solving (OECD, 2023). At the national level, the emphasis on numeracy through the National Assessment (AKM) further reinforces the urgency of strengthening not only procedural skills but also reasoning and resilience in tackling non-routine tasks (Hidayah et al., 2024; Kinanti et al., 2023). These challenges become more visible in foundational algebra topics, where students are required to transition from arithmetic thinking to symbolic reasoning. In practice, students often experience difficulties in linear equations in one variable (LEOV), as instruction tends to emphasize procedures rather than conceptual understanding and sustained reasoning when initial strategies fail (Anggraini et al., 2023; Kinanti et al., 2023).

In response to these challenges, the literature highlights that the quality of mathematical reasoning is closely linked to students' disposition to persist productively. Frameworks such as the Standards for Mathematical Practice and recommendations from NCTM emphasize the importance of productive struggle, where students are expected to interpret problems, plan solution pathways, and persist through difficulties (Fukawa-Connelly et al., 2018; Heck et al., 2012; Warshauer, 2014). In this perspective, perseverance is not merely about effort duration but about maintaining coherence, control, and validity in reasoning processes. Building on this view, Perseverance in Mathematical Reasoning (PiMR) emerges as a more specific construct that conceptualizes perseverance as the ability to sustain a coherent line of reasoning despite cognitive or affective challenges (Barnes, 2019, 2021). PiMR involves the interaction of cognitive, affective, and conative components and is evident when students revise strategies, reevaluate steps, and validate arguments. Thus, learning environments that support productive struggle(providing opportunities for reflection, representation, and argumentation) are essential for fostering PiMR.

While PiMR explains how perseverance operates within reasoning processes, understanding why students differ in their responses to difficulty requires an additional perspective. The concept of Adversity Quotient (AQ) offers such a lens by explaining how individuals respond to challenges through the CORE dimensions: Control, Ownership, Reach, and Endurance (Stoltz, 1997). In mathematics learning, AQ helps explain why some students persist in maintaining reasoning while others disengage or shift to less productive strategies. In particular, students with a Climber profile tend to continue striving despite obstacles, making them relevant subjects for examining perseverance in reasoning processes. Previous studies have linked AQ to mathematical performance and thinking processes, including problem solving and reflective reasoning, often by comparing climber, camper, and quitter types (Anwar et al., 2024; Charolina & Suhendra, 2025; Hidayat et al., 2018).

Despite these insights, existing studies largely focus on outcomes or general strategy descriptions, with limited attention to micro-level analysis of perseverance during reasoning processes. More importantly, research explicitly connecting PiMR with AQ dimensions (CORE) remains scarce, particularly in the context of LEOV tasks that frequently involve conceptual misunderstandings and require strategy revision. This limitation is critical, considering that LEOV serves as a foundational topic in algebra where students first engage with variables, equivalence, and abstract reasoning. Insufficient development of reasoning perseverance at this stage may lead to difficulties in more advanced mathematical concepts (Anwar et al., 2024; Dewanti, 2018; Hasanah et al., 2019). Therefore, a more integrated analysis that links perseverance in reasoning with students' responses to adversity is needed. This study offers novelty in the form of a more explicit link between perseverance in mathematical reasoning (as a disposition and reasoning behavior that can be observed during problem solving, in line with the practice of make sense and persevere and productive struggle) with aspects of AQ (CORE) as a lens to interpret why and how perseverance appears in Climber type students. Thus, the contribution of this study is not only to capture the quality of mathematical steps, but also to understand the cognitive-dispositional resilience that supports reasoning when students face obstacles.

Addressing this gap, this study aims to describe how climber students' PiMR manifest throught the CORE dimensions (Control, Ownership, Reach, Endurance) when solving LEOV task. Using an in-depth qualitative approach, this study examines how students interpret problems, maintain coherence of reasoning, revise strategies when encountering obstacles, and validate their arguments and solutions. By integrating PiMR and AQ as a unified analytical framework, this study seeks to provide a deeper understanding of how reasoning perseverance is constructed and sustained in mathematical problem-solving contexts.

Methods

The research employed qualitative methods which followed a single-case study design. The researchers selected this design because it aimed to study Climber-type students' detailed mathematical reasoning process during LEOV problem-solving which included their strategic development and their reasoning methods and their step verification techniques and their reactions to dead ends (Fudin et al., 2022; Nur et al., 2022; Syamsyiah & Handayani, 2023). The research investigation focused on analyzing student reasoning patterns which developed through their work with LEOV tasks instead of evaluating treatment outcomes.

The study population was comprised of students of class VIII A of SMP Negeri 9 Jambi City during the study year. Sampling was conducted purposively based on the Adversity Quotient measurement results using the Adversity Response Profile (ARP) questionnaire. All class VIII A students first completed the ARP according to the instructions, then the scores were calculated to group students into Climber, Camper, and Quitter categories. The research subjects were then selected from the Climber group by considering the completeness of the data, willingness to participate, and variations in mathematical abilities (e.g., based on teacher information/grade recap) to enrich the obtained profiles and allow for comparison of reasoning patterns within the Climber group. Based on the ARP test, 3 students were found in the climber category. Of these three students, one student was selected for further in-depth research. These students showed the strongest and most consistent indications of Perseverance in Mathematical Reasoning (PiMR) during the initial stages of data collection (tests and observations).

The research instruments included (1) an ARP questionnaire which determined AQ types and showed how participants handled the CORE dimensions (Control, Ownership, Reach, Endurance) and (2) a LEOV test which used essay questions to measure students' reasoning abilities (problem interpretation and strategy development and result explanation and validation). The observation sheet documented student reasoning perseverance through their test actions which included different strategy attempts and step verification and maintaining efforts after initial wrong answers and visual representation use. The researchers used a semi-structured interview protocol to understand students' decision-making processes and their interpretation of challenges and their connection to AQ characteristics. The test, observation, and interview instruments were designed based on indicators of mathematical reasoning and indicators of perseverance in the reasoning process; their feasibility was assessed through expert judgment from 2 lecturers (content and language) and 1 expert teacher (practicality of use), s well as limited trials to ensure readability and suitability of difficulty levels for groups of grade VII students outside of grade VII A.

Data collection was conducted sequentially and in an integrated manner. Initially, an Adversity Response Profile (ARP) was administered to all students in grade VIII A to categorize their AQ types and determine their Climber-type subjects. Selected subjects then individually took a linear equations test in one variable (LEOV), accompanied by structured observations to record behaviors that demonstrate persistence in reasoning. After the test, semi-structured interviews were conducted to explore the reasons for strategy selection, the process of answer verification, and responses to obstacles. All supporting data, including student worksheets, observation notes, and interview transcripts, were coded anonymously to maintain participant confidentiality.

Data analysis followed the procedures of Miles & Huberman (2014), which include data reduction, data presentation, and drawing and verifying conclusions. In the reduction stage, data were read repeatedly and coded based on reasoning indicators (e.g., justification, consistency, and generalization) and persistence indicators (e.g., strategy revision and revalidation). The coding results were then presented in case descriptions per subject, containing the sequence of LEOV completion, points of resistance, subject responses, and their relationship to AQ dimensions (see Table 1).

Table 1. Interpretation of PiMR on AQ (Rasyid et al., 2025)

PiMR Aspects	Core Dimention of AQ	PiMR Indicators	Signs Observed During Observation*	Things Explored in Interviews*
Striving	Control–Endurance	1. Exploring various	- Students try several methods before	- Students' strategies for solving problems

PiMR Aspects	Core Dimention of AQ	PiMR Indicators	Signs Observed During Observation*	Things Explored in Interviews*
		possible solutions	determining the final answer - Students consider different approaches to solving problems	- Considerations in choosing an approach to solving problems
		2. Efforts to overcome challenges	- Students remain persistent, focused, and do not give up easily when facing difficulties in solving problems	- Resilience in facing difficulties
		3. Seeking evidence to support their answers	- Students double-check their answers and recalculate them answers	- Habit of checking answers before considering them complete
		4. Correcting mistakes	- Students identify mistakes in their work and try to correct them - Students do not simply erase their answers but try to correct them	- The ability to identify and correct mistakes
Self-regulatory processes	Ownership, Control, and Reach	5. Reflection on previous attempts	- Students appear to evaluate previous steps	- Evaluation of previous steps in solving problems - Students' ability to reflect on the results of their work
		6. Adjustment or improvement of strategies	- Students change methods, strategies, or calculations in solving problems when the methods or calculations applied prove to be ineffective in solving the problem - Students consciously stop using ineffective methods and switch to other strategies to solve the problem	- Ability to change problem-solving methods - Students' ability to stop ineffective methods and switch to other strategies
		7. Monitoring emotions and controlling feelings	- Students show signs of frustration or stress but continue with their work - Students use techniques to calm themselves, such as taking deep breaths or talking to themselves	- Students' attitudes toward difficulties and frustration - How students cope with stress or frustration in solving problems
Active goals	Endurance Control	8. Focus on understanding	- Students can summarize the problem in the question. Whether students understand the context of the question can be seen from how they rephrase	- Students' ability to understand the problems in the questions and solve them according to the context of the problems

PiMR Aspects	Core Dimention of AQ	PiMR Indicators	Signs Observed During Observation*	Things Explored in Interviews*
			the question or the concepts used to solve the problem	- How do students ensure that they understand the problems in the questions well
		9. Focus on conducting many successful trials	- Students try various attempts at solving the problem until they succeed	- Willingness to try various methods in solving the problem until successful
		10. Setting an ultimate goal	- Students focus on achieving the desired results	- Students' focus on achieving the desired results

The striving aspect of PiMR reflects students' active efforts to remain engaged in the reasoning process despite facing difficulties. Indicators such as exploring various solutions, attempting to overcome challenges, seeking evidence, and correcting errors demonstrate that students possess Control, the ability to maintain control of the thought process and not lose direction when faced with obstacles. At the same time, the continuity of these efforts also reflects Endurance, the resilience to persist and not give up before finding a valid solution. Thus, striving represents a combination of the ability to control the process (control) and perseverance in carrying it out (endurance).

Self-regulatory processes relate to how students manage, evaluate, and adjust their thinking processes. Indicators of reflection on previous experiments and strategy adjustments indicate ownership, namely awareness and responsibility for mistakes and a willingness to correct them. Furthermore, the ability to monitor thought processes and emotions indicates control, as students are able to regulate cognitive and affective responses when faced with difficulties. Meanwhile, the ability to regulate emotions and not allow difficulties to disrupt the overall thinking process reflects reach, namely the ability to limit the impact of problems so they do not spread and hinder overall performance. Therefore, self-regulatory processes are an integrative representation of ownership, control, and reach.

The active goals aspect describes the goal orientation that guides students' reasoning activities. Focusing on understanding, striving for successful experiments, and setting final goals demonstrate that students have a clear direction in their thinking process. This relates to control, as students are able to maintain focus and direct strategies toward the desired goal. Consistency in maintaining goals until they are achieved reflects endurance, namely the resilience to continue trying until results meet the criteria for mathematical truth. Thus, active goals link goal orientation with process control and resilience in achieving them.

The reliability of the findings was maintained through triangulation of data sources (tests, observations, and interviews), expert assessment of the coding scheme and interpretation of the findings, and limited member checking, where subjects were asked to confirm that the summary of the findings matched the steps and rationale they presented. These procedures ensured that the resulting PiMR profiles were supported by consistency across data and accountable interpretations.

Results

This study involved one subject in the *Climber* category, given the initials AA. Broadly speaking, PiMR indicators can be identified based on the results of the test, interviews, and observations. Furtur details regarding the achievement of these indicators are explained in the following results.

Striving

While working on the problem, AA appeared to be actively exploring various possible solutions. This is evident in Figure 1, where the calculations illustrate several purchasing alternatives.

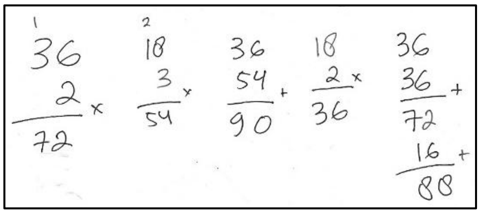


Figure 1. AA’s exploration of alternative purchasing combinations

Based on AA's work on the questions in Figures 2 and 3, it appears that AA was able to face the challenges/difficulties encountered. AA created a model of the problem (Figure 2) which led to finding suitable purchase options that stayed within budget (Figure 3).

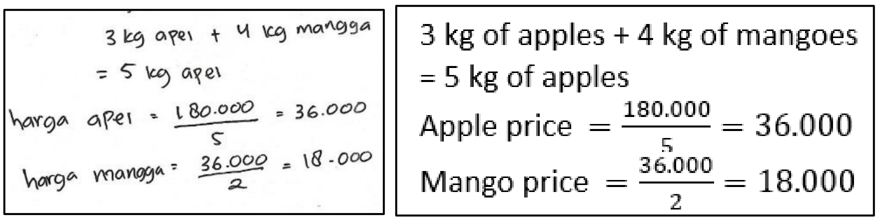
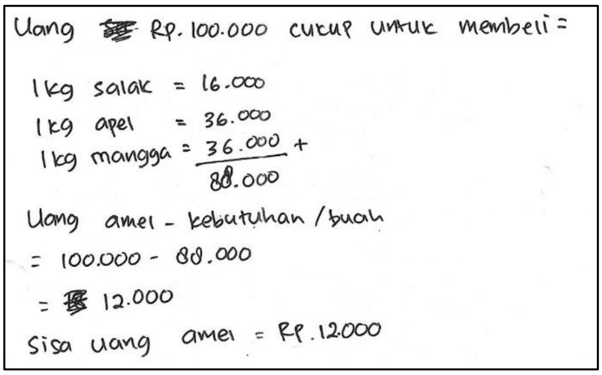


Figure 2. AA's mathematical model

The observations showed that AA showed resistance to challenges when working on mathematical reasoning tasks. Through in-depth interviews, it was found that AA had experienced difficulties but was then able to solve them. This is based on AA's statement that "At first, I was confused about understanding the meaning of the problem and how to convert it into mathematical form. I also didn't know how to find the answer. But after I tried again slowly, I finally managed to do it."



Rp. 100.000 is enough to buy:
1 kg of snake fruit = 16.000
1 kg of apples = 36.000
2 kg of mangoes = 36.000 +
88.000
Amel's money – necessities/fruit
= 100.000 – 88.000
= 12.000
Amel's remaining money = Rp. 12.000

Figure 3. AA's final answer results

To illustrates his answer was correct, AA exemplifies his ability to verify it by recalculating the unit price of the fruit. As seen in Figure 4, AA checked his calculation by multiplying the quantity and the price per kilogram, then adding them together again to ensure his answer matched the question.

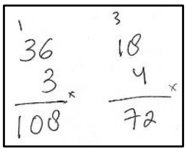


Figure 4. AA's scribbles in search of supporting evidence

AA was able to identify and correct the calculation error. This can be seen in Figure 5, which shows a correction from the initial result of 150 to 180. Based on the interview, AA realized the error by forgetting to add the savings figure to the calculation and then reviewed his answer. This is based on AA's answer during the interview, "At that time, I just realized that I forgot to add the number saved from the previous multiplication into the calculation. After I checked my answer again, I saw the mistake."

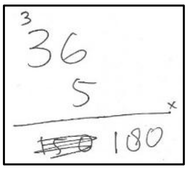


Figure 5. Correction of AA's answer

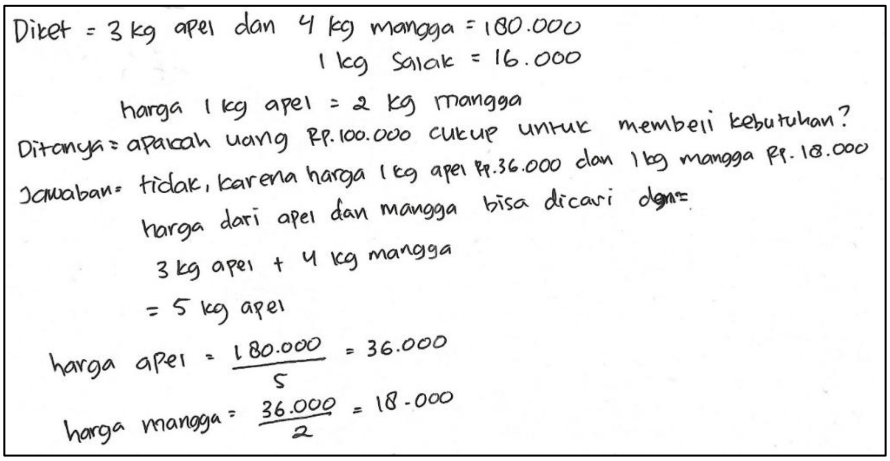
Self-regulatory processes

AA showed reflective behavior through his practice of checking all solution steps before starting his error correction work. He evaluated the calculation process and results to ensure the answer matched the information in the problem. The practice had become a routine for him because he used it to check and evaluate all his work steps for potential mistakes. AA showed his ability to change his problem-solving approach through his understanding of the concepts. He solved the problem through modeling which involved converting mango quantities into apple equivalents until he reached a total of 5 kg apples. The company selected this method because it made their calculation process easier while demonstrating their ability to understand fruit price connections and their preference for using straightforward mathematical methods. AA showed they could handle emotional stress which occurred while working on problem-solving tasks. He managed to stay calm through his panic and tension by stopping work to breathe before he resumed his tasks. AA controlled his emotions because he needed to maintain focus which exemplifies his capacity to manage difficult emotions. AA said this during an interview, "I try to stay calm because I feel I have to focus on solving the problem. If I'm upset or panicking, I usually lose my concentration. So, as much as possible, I don't put aside my annoyance even though I feel like I'm facing a dead end."

Active goals

AA worked to identify multiple alternative solutions which they pursued throughout the entire process. The observations in Figure 1 demonstrate that AA tested multiple different solutions until it discovered the method which it considered both effective and financially beneficial.

AA exemplifies a good understanding of the problem context (see Figure 6). The team at AA converted the problem into a functional format which allowed them to retrieve essential information through proper mathematical methods. In solving problems, AA first understanding the problem's objective and recording all available data before he remembered previous solutions he had learned. This information was obtained from interviews where AA stated, "First, I try to understand the purpose of this problem, then I record all available data. After that, I recall the methods or solutions I've learned previously to solve it."


Diket = 3 kg apel dan 4 kg mangga = 180.000
1 kg Salak = 16.000
harga 1 kg apel = 2 kg mangga
Ditanya = apakah uang Rp.100.000 cukup untuk membeli kebutuhan?
Jawaban = tidak, karena harga 1 kg apel Rp.36.000 dan 1 kg mangga Rp. 18.000
harga dari apel dan mangga bisa dicari dgn =
3 kg apel + 4 kg mangga
= 5 kg apel
harga apel = $\frac{180.000}{5}$ = 36.000
harga mangga = $\frac{36.000}{2}$ = 18.000

Given: 3 kg of apples and 4 kg of mangoes = 180.000
1 kg of snake fruits = 16.000
Price of 1 kg apples = 2 kg mangoes
Questions: Is Rp. 100.000 enough to buy necessities?
Answer: No, because the price of 1 kg of apples is Rp. 36.000 and 1 kg of mangoes is Rp. 18.000
The price of apples and mangoes can be found as:
3 kg of apples + 4 kg of mangoes
= 5 kg of apples
Apple price $= \frac{180.000}{5} = 36.000$
Mango price $= \frac{36.000}{2} = 18.000$

Figure 6. AA's understanding of mathematical reasoning problems

AA kept their attention on the task while using established methods to achieve their predefined objective. As seen in Figure 7, AA calculated the total fruit requirement and concluded that Rp100,000 was insufficient. He needed to find budget-friendly options which would work within his limited financial resources. The solution developed by AA stayed under Rp100,000 because the team kept their defined goals and their ability to adapt their solution approach.

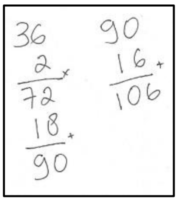


Figure 7. AA's notes calculating Amel's purchase needs

Discussion

The research results show that students at the Climber (AA) level demonstrate excellent perseverance in mathematical reasoning (PiMR) during LEOV problem-solving through three primary behaviors which include striving and self-regulatory processes and active goal management (Hendriana et al., 2018; Hundeland et al., 2020). The pattern follows the Climber character from the Adversity Quotient (AQ) who deals with obstacles by treating them as workable problems which they will continue to work on until they discover the best answer (Fernández-León et al., 2021; Stoltz, 1997). In the context of mathematical reasoning, AA perseverance is not only seen in "working longer", but in the quality of the reasoning process: interpreting problems, maintaining coherence of reasoning, changing strategies when stuck, and validating results which are important components in learning mathematical reasoning (Eraky et al., 2022; Hadi, 2025; Pradini, 2019) and problem-solving competencies emphasized in large scale assessments such as PISA (OECD, 2023; Tampa et al., 2022).

Striving and its relationship to AQ (Control–Endurance)

In the striving aspect, AA appears to be actively exploring several possible solutions as reflected in the alternative sketches in Figure 1. This behavior demonstrates productive perseverance: AA does not stop at one approach, but continues to search for solutions until he finds a purchasing alternative that meets the budget constraints (Figure 3). Within the AQ framework, this pattern reflects strong Control and Endurance. The control system becomes apparent through AA's ability to lead his mental operations despite his lack of understanding about the situation and his inability to create models (Figure 2) and his determination to finish his work (Stoltz, 1997; Warshauer, 2014). The research supports the theory which shows that students can keep reasoning through mathematical problems when their mental focus stays active (Barnes, 2019), Students will keep reasoning when their mental focus stays active but panic emotions will block their progress if they do not learn to control them (Barnes, 2021; Eraky et al., 2022; Hendriana et al., 2018).

The research of AA provides evidence for PiMR through its method of result verification by performing double checks (Figure 4). She repeated the multiplication of quantities with unit prices before checking the results against the problem requirements. In reasoning, this consistency and validation checking activity is an indicator that students are not simply “generating answers” but are building reason-based beliefs (Hadi, 2025; Säfström et al., 2024). When AA discovered an error (correcting 150 to 180 in Figure 5), she corrected the procedure after realizing a missing component (forgetting to add a savings). This pattern of errors and corrections aligns with the error analysis literature: errors can arise from inaccuracy/oversight or unstable procedures, and correction occurs when students review the information and operations used (Anggraini et al., 2023; Chong et al., 2019). Thus, AA striving is not just “persistent”, but perseverance that is oriented towards the accuracy of reasoning (Hadi, 2025; Richit et al., 2021; Syamsyiah & Handayani, 2023).

Self-regulatory processes as a bridge between PiMR and AQ (Ownership, Control, and Reach)

In terms of self-regulatory processes, AA exemplifies strong self-regulation: reflection on steps, evaluation of results, and selection of more efficient strategies. She reviewed steps before correcting errors and confirmed that she used the habit of double-checking to avoid errors. According to PiMR, this indicates the presence of metacognitive monitoring and control, components that maintain coherence in reasoning when students encounter obstacles (Barnes, 2019; Eriksson & Sumpter, 2021; Säfström et al., 2024).

The connection between AQ and Ownership emerges because AA takes full responsibility for the mistake which she made by omitting a savings account according to Stoltz (Stoltz, 1997). AA demonstrates Control through her emotional distress management skills. She stops her panic attack by taking a breath before she continues with her actions. The basic method enables students to handle their emotions while maintaining active mental processing according to research about student affect management (Barnes, 2021; Hundeland et al., 2020).

The Reach aspect is also reflected: AA appears to be able to “limit the reach” of the impact of difficulties. The initial challenges he faced in understanding the situation did not make him stop working or abandon the entire process because he kept going back to the core data to create a mathematical model. In problem-solving learning, this ability to limit the effects of obstacles often occurs in individuals with more adaptive AQ and more flexible representational strategies (Fudin et al., 2022; Hundeland et al., 2020; Nur et al., 2022). AA's strategy of converting the number of mangoes to apples to simplify the total (to 5 kg of apples) demonstrates representational flexibility and reasoning efficiency, rather than simply following a common procedure. This reinforces the idea that Climber's self-regulation can emerge as a strategic adaptation when encountering an impasse (Fernández-León et al., 2021; Warshauer, 2014).

Active goals and their relationship with AQ (Endurance Control) in maintaining the direction of reasoning

In the active goals aspect, AA exhibits clear and dynamic goals: he concludes that Rp100,000 is not enough (Figure 7), then sets a follow-up goal to explore alternative purchases within the budget until he finds a solution with a total cost below the limit. The research study PiMR shows that participants can stay focused on their goals through strategy changes which they make after receiving additional information. The ability to maintain goal focus through strategy adjustments based on new information shows non-rigid but purposeful perseverance (Barnes, 2019; Hadi, 2025; Rasyid et al., 2025). The behavior in AQ demonstrates two characteristics which are Endurance and Control because the person continues working until they reach their objective while making strategic decisions to succeed. The behavior pattern of Climbers (Fernández-León et al., 2021; Stoltz, 1997).

Students in the AA process follow a specific problem-solving sequence which includes reformulation and important information identification and activation of their previous learning (Figure 6). The research method examines how people understand problems and their meaning development process through this approach. People who use constructive meanings in problem-solving tend to explore solutions and build their ability to handle challenges (Hendriana et al., 2018; Martino, 2018). From a learning practice perspective, AA behavior suggests that active goals can be strengthened through the practice of tasks that require justification, setting intermediate goals, and verifying results, aligning with effective teaching practices and formative assessments oriented toward learning trajectories (Fernández-León et al., 2021; Hundeland et al., 2020).

Synthesis of the relationship between PiMR and AQ in Climber students in LEOV

Synthetically, the perseverance profile in mathematical reasoning (PiMR) in Climber (AA) type students appears to be built by the integration of four dimensions of Adversity Quotient (AQ): Control, Ownership, Reach, and Endurance (Stoltz, 1997). Control is evident when AA is able to maintain focus on reasoning and manage emotions (e.g., calming oneself during panic) so that the modeling, calculation, and decision-making processes continue; this affective control is important because perseverance in reasoning arises from the productive interaction between cognition and affect (Barnes, 2019, 2021). Ownership is evident when AA acknowledges the source of an error (forgotten information) and makes improvements through reviewing steps, demonstrating responsibility for the quality of the reasoning and results, in line with the finding that answer revision occurs when students consciously evaluate the procedures and information used (Anggraini et al., 2023). Reach is reflected in AA's ability to limit the impact of initial difficulties (understanding the context and building a model) so that they do not disrupt the overall solution; He returns to important information and reorganizes the representation/strategy, demonstrating representational flexibility and strategic adaptation when faced with impasses (Fudin et al., 2022; Nur et al., 2022). AA chooses Endurance because they keep searching for different solutions until they find one which meets all the requirements of the problem. The team proves their solution through multiple calculations and correction procedures which show their commitment to logical thinking (Hadi, 2025; Säfström et al., 2024). The PiMR system of AA demonstrates Climber's adaptive AQ through its approach to handle obstacles as workable obstacles and its practice of using errors to develop reflection skills and its ability to modify strategies through purposeful action and its dedication to find solutions until it discovers an appropriate answer (Stoltz, 1997; Warshauer, 2014).

This study has several limitations that require attention when interpreting the findings. First, the use of a single-subject design limits the transferability of the results to broader contexts and populations, requiring caution in generalizing the findings. Second, the researcher's data interpretation is potentially subject to subjective bias, despite efforts to maintain data validity. Third, the LEOV task used in this study may not fully represent all dimensions of perseverance in mathematical reasoning (PiMR), thus leaving certain aspects unexplored. Fourth, the self-report nature of the ARP questionnaire also has limitations, as participants' responses may not always reflect their true adversity quotient (AQ). Therefore, future research is recommended to incorporate more diverse research designs, use more comprehensive instruments, and employ stronger data triangulation techniques to enhance the validity and exploratory power of the findings.

Conclusion

This study contributes by linking Persistence in Mathematical Reasoning (PiMR) and Adversity Quotient (AQ) as an integrated analytical lens to interpret variations in students' reasoning persistence episodes in completing LEOV tasks. Findings indicate that Climber (AA) students maintain high reasoning persistence through three core PiMR characteristics: maintaining coherence of reasoning through exploration and verification of solutions, adaptively revising strategies when faced with obstacles, and maintain focus. These characteristics align with the integrated workings of the AQ dimensions, where Control supports focus and emotional regulation, Ownership encourages responsibility for errors and corrections, Scope enables transitions between strategies and representations, and Resilience sustains reasoning until solutions are validated. The implications of these findings emphasize the need for learning that provides space for productive struggle, habituates the practice of validation and reflection, and systematically strengthens students' self-regulation. This can be done by teachers through the use of 'think aloud' protocols during LEOV instruction to model strategy revision, or incorporating error analysis tasks where students identify and correct misconceptions. So that the persistence that develops is not just persistence in work, but persistence in mathematical reasoning. Therefore, future research should examine PiMR across multiple Climber students to identify within-type variation, and explore instructional interventions designed to foster reasoning-specific perseverance.

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Declarations

Conflicts of Interest	:	The authors declare no conflict of interest and have completed an ethics review (plagiarism, ethical violations, data fabrication/falsification, multiple submissions/publications, and redundancy).
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