Pertanika J. Soc. Sci. & Hum. 34 (S4): 1 - 18 (2026)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Exploring the Adversity Quotient (AQ) of Future Elementary School Teachers in Numeracy Problem Solving

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ABSTRACT

This study investigates the relationship between Adversity Quotient and mathematical thinking stages among prospective elementary school teachers. It focuses on three Adversity Quotient types: climbers, campers, and quitters. Participants included students from the Elementary School Teacher Education Study Programme. Data were collected through Adversity Quotient questionnaires and semi-structured interviews, analysed qualitatively through data reduction, interpretation, and conclusion drawing. Findings indicate that climber-type students effectively engage in all mathematical thinking stages: specialising, generalising, conjecturing, and convincing. In contrast, camper-type students often rely on irrelevant data, leading to pseudo-generalisation. Quitter-type students only attempt specialising and conjecturing stages, hindered by their limited thinking skills. The study highlights the importance of fostering a higher Adversity Quotient in students to enhance their mathematical problem-solving abilities.

ARTICLE INFO

Article history:
Received: 11 July 2025
Accepted: 10 July 2026
Published: 25 September 2026

DOI: https://doi.org/10.47836/pjssh.34.S4.01

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Keywords: Adversity Quotient, numeracy, problem solving

INTRODUCTION

Numeracy is increasingly recognised as a fundamental life skill that extends beyond the boundaries of mathematics. Reports from international large-scale assessments such as PISA and TIMSS consistently highlight the challenges faced

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by students in developing robust numeracy skills. Indonesia, like many developing nations, has been striving to improve its educational outcomes, yet difficulties persist in enabling students to reason numerically and apply mathematical knowledge to real-life contexts. This issue becomes even more pressing when considering the future role of elementary school teachers, who are expected to foster the early numeracy foundations critical for lifelong learning.

The importance of Adversity Quotient (AQ) in this discourse cannot be overstated. AQ embodies perseverance, problem-focused coping strategies, and resilience when facing complex tasks. In education, AQ complements constructs such as grit, resilience, and self-regulation, but it provides a more nuanced framework to explain how individuals persist or disengage when encountering mathematical challenges. For prospective elementary school teachers, cultivating a high AQ means equipping them not only with mathematical competencies but also with the emotional and cognitive endurance necessary to guide young learners in numeracy development. Therefore, embedding AQ in teacher education curricula is vital to prepare teachers who are resilient educators capable of handling diverse classroom challenges.

Mathematical thinking is an important aspect of learning, so it needs to be placed as the main learning goal (Ferdianto et al., 2022). By knowing the ability to think mathematically, students can be better prepared to face mathematical problems. Students' in-depth understanding of mathematical concepts can encourage the development of logical thinking skills so that they can represent most of students' skills in studying at the basic education level (Sitopu, 2024). Furthermore, the lack of teachers' habits in implementing numerical literacy in school results in students experiencing difficulties when solving numeracy problems (Sayekti et al., 2022). The lack of teachers' ability to teach numeracy problems results in a lack of student understanding, so it is necessary to produce prospective teacher students who are able to teach numeracy problems.

If you see the phenomenon of teachers' difficulties in teaching numeracy problems, it is necessary to produce prospective teacher students who can teach how to solve numeracy problems. The difficulties of prospective teacher students in solving numeracy problems can be identified through adversity quotients. The results of the study stated that students' persistence or effort in solving mathematical problems can be identified through three types of adversity quotients. Each type of AQ student has a different response to mathematical problems (Nikam & Uplane, 2013; Triwahyuningtyas et al., 2023). Students with high AQ types are more proficient in solving problems compared to students with medium AQ and low AQ types (Anwar et al., 2024). Students with medium AQ and low AQ categories are more likely to give up when facing math problems that are considered difficult. Other research also shows a link between adversity quotient and metacognition because both are related to students' thinking activities in solving problems (Jemina et al., 2022).

The results of research in the last ten years show that not many have studied students' mathematical thinking activities in solving numeracy problems (Chang, 2023; Ferdianto et al., 2022; Hariyani et al., 2022; Hwang, 2020; Okigbo & Okonkwo, 2023; Purnomo et al., 2022; Sitopu, 2024). The research discusses the development of numeracy problems, so it is necessary to conduct research on the exploration of mathematical thinking activities of prospective teacher students so that there are no more graduate students who are prospective teachers who experience difficulties when teaching numeracy problems. Therefore, this study aims to explore the mathematical thinking activities of prospective teacher students in solving numeracy problems reviewed from Adversity Quotient.

LITERATURE REVIEW

Mathematical thinking frameworks based on Mason's (2010) are specialising-generalising-conjecturing-convincing model, can be effectively integrated with AQ to better understand how perseverance manifests in specific cognitive stages. For instance, students with climber-type AQ are likely to persist through conjecturing and convincing, while quitter-type students may disengage after initial specialising attempts. This integrative approach opens new avenues for teacher education research, emphasising both cognitive and non-cognitive factors in numeracy teaching.

Adversity Quotient (AQ) is defined as the persistence of students in overcoming obstacles faced to achieve the desired success (Nikam & Uplane, 2013; Suryadi & Santoso, 2017). The quitter type is the type of student who tries to escape from problems. Quitter students find math complicated and confusing, so they have no motivation to solve problems. The camper type is a student who does not want to take risks, so he feels satisfied with the situation that has been achieved so far. While the climber type is a student who has a target so that he is tenacious and persistent to be able to achieve the desired target. Climber students have courage and discipline. In terms of learning mathematics, students with the *climber* type feel happy to learn mathematics because they feel challenged (Amir et al., 2021). Each type of adversity quotient is closely related to a person's ability to think in overcoming difficulties (Jemina et al., 2022).

The persistence of students in solving numeracy problems is inseparable from their mathematical thinking skills. Mathematical thinking is an ability that students must have in order to build knowledge when solving mathematical problems (Çelik & Özdemir, 2020). Students' mathematical thinking skills can be built through the process of assimilation and accommodation. Assimilation is the process of incorporating new information into an existing scheme. Meanwhile, accommodation is the process of adjusting the scheme that already exists in the student's brain with a new scheme (Faizah et al., 2022a). Students can carry out assimilation and accommodation processes to construct their knowledge. Mathematical

thinking is also carried out through students' cognitive activities that can be observed through written and spoken language, arithmetic symbol operations, and axiomatic formal symbols (Rahayuningsih et al., 2021).

The ability to think mathematically needs to be possessed by every student, especially prospective elementary school teachers. This is because mathematical thinking is a provision to become a professional educator and is ready to become the best facilitator in mathematics learning in schools, especially in elementary schools (Tohir et al., 2020). Mathematical thinking starts from the experience of several phenomena that can trigger questions (Mason, 2010). Mathematical thinking skills can be known through the process of abstraction, synthesis, generalisation, modeling, problem solving, and verification (Tall, 2002; Yorulmaz, 2017). Furthermore, Mason (2010) mentioned that mathematical thinking skills are carried out through several stages, namely: entry, attack, and review. Each of these stages contains several aspects. At the entry stage, it contains know, want, and introduction.

Students understand the problem carefully by grouping and sorting out information. Then in the attack stage there are try, maybe, and why. Students submit conjectures and then try these conjectures to solve the problem. Meanwhile, the review stage contains aspects of check, reflect, and extend. Students check the accuracy of the results of problem solving. In addition to these three stages. Mason (2010) also mentioned that in identifying students' mathematical thinking skills, there are four important processes. First, Specialising is the stage of specialising in problems such as making a pattern or picture and arranging parts of the problem such as what is known and what is asked. Second, generalising is the activity of looking for solutions and how to test the truth steps of an alleged solution. Third, conjecturing is the activity of making conjectures from patterns or methods that have been made. The conjectures that have been made are tested for truth and if the conjecture is wrong, a new conjecture must be made until the right solution is found. Fourth, convincing is students' confidence in the results of problem solving. This belief can be shown by explaining each completion step that has been carried out based on the numeracy concepts that students understand.

The four stages of mathematical thinking are closely related to the Adversity Quotient because it is to find out the persistence of prospective elementary school teacher students in solving numeracy problems. If mathematical thinking ability is known, it is hoped that students will not experience problems when solving numeracy problems. If there are still students who experience problems, it is necessary to provide scaffolding. According to Faizah et al. (2022b), the provision of scaffolding can be done by more expert people, in this case it can be colleagues or lecturers. In this study, the exploration of students' mathematical thinking activities from each type of adversity quotient was identified based on four important processes, namely

specialising, generalising, conjecturing, and convincing.

Research on AQ demonstrates strong correlations with academic achievement, motivation, and resilience across disciplines. Stoltz (1997), who originally coined the concept, emphasised that individuals with high AQ are more likely to transform obstacles into opportunities, a quality that resonates strongly within mathematics education. Comparatively, Duckworth's notion of grit and Bandura's concept of self-efficacy share similarities with AQ, but AQ uniquely emphasises the behavioural responses to adversity. This makes it particularly relevant for mathematical problem solving where frustration and cognitive disequilibrium are common experiences.

In the Indonesian context, research linking AQ to numeracy is still emerging. Studies have shown that students with high AQ demonstrate stronger problem-solving persistence, greater metacognitive awareness, and a tendency to engage in higher-order reasoning strategies. Moreover, AQ has been linked with socio-cultural aspects of learning, as collectivist cultures often emphasise communal resilience and perseverance. Prospective teachers, therefore, need explicit opportunities to develop their AQ through problem-based learning, reflective practice, and scaffolded experiences in teaching numeracy.

Cultural values significantly shape how adversity and resilience are perceived in educational contexts. In collectivist societies like Indonesia, perseverance is often framed in terms of communal responsibility and respect for teachers. Students may persist not only for personal success but also to uphold family expectations or contribute to group achievements. This contrasts with more individualist cultures, where resilience is often viewed as personal grit or self-determination. Recognising these cultural nuances is critical for developing AQ interventions that are culturally responsive and contextually relevant.

Moreover, Indonesian educational traditions emphasise moral and character education, which aligns well with AQ development. Embedding AQ in this context does not require importing foreign concepts to wholesale but rather adapting them to local values. For example, the concept of mutual cooperation (*gotong royong*) can be harnessed to frame perseverance as a shared classroom responsibility. Such cultural grounding ensures that AQ development is meaningful, authentic, and sustainable.

METHODS

This study followed rigorous ethical and methodological protocols. Prior to data collection, ethical clearance was obtained from the institutional research committee, ensuring compliance with confidentiality, informed consent, and voluntary participation. Participants were briefed on the aims of the study and assured that pseudonyms would be used to protect their identity.

The AQ questionnaire was validated through expert judgment involving specialists in mathematics education and

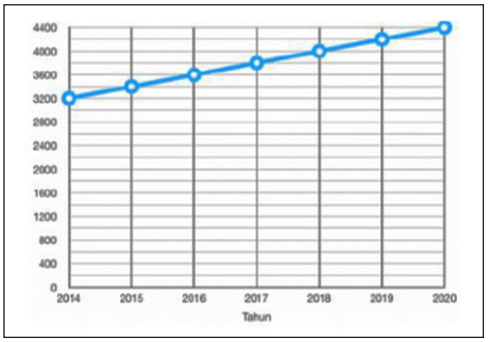
educational psychology. Reliability was tested using Cronbach's Alpha, producing a coefficient of 0.82, which indicates strong internal consistency. The numeracy problem test underwent pilot testing with 10 students outside the research sample to refine the clarity of instructions and graphical representations. Semi-structured interview protocols were also peer-reviewed to ensure alignment with the research objectives. For data analysis, coding procedures were carried out iteratively. Open coding was applied to initial transcripts, followed by axial coding to establish connections between AQ types and stages of mathematical thinking. Triangulation was achieved by comparing written tests, interview responses, and researcher observations. Inter-rater reliability was enhanced by involving two independent coders who cross-checked emerging themes. The resulting data corpus was then subjected to thematic interpretation guided by Creswell's (2014) framework.

This research is included in the type of exploratory descriptive with a qualitative approach. This research was conducted on forty prospective teacher students who are taking the Basic Mathematics Education and Concepts Course in the Elementary School Teacher Education Study Programme. The selection of research subjects was carried out using an *adversity quotient* questionnaire to classify students. From each type of *adversity quotient*, two students were selected to be the subject of research so that there were six students who would be given a written test on numeracy problems. Students who have been selected as research subjects and have completed the test will be interviewed in depth to explore their mathematical thinking activities.

The instruments used in this study are numeracy problem tests, *adversity quotient* questionnaires, and interviews. The researcher conducts the instrument validation process to the expert validator before the instrument is given to the student. During the interview process, the researcher recorded using a video *tape recorder* to facilitate the transcript process. The interview was used to explore the mathematical thinking activities of the research subjects when completing a numeracy problem test. The test instruments used in this study are presented in Figure 1.

The research procedure is carried out through four stages. In the first stage, the researcher made observations during the

Written Test:
There is a clothing factory called "the companies of like to prosper". The factory started producing clothes in 2014 with a lot of production as in the following table:



How many apparel will the " the companies of like to prosper" factory produce in 2024?

Figure 1. Written test

lecture process in the course "Education and Basic Concepts of Mathematics." In the second stage, the researcher gave an adversity quotient questionnaire to determine the research subject. In the third stage, the researcher gave a numeracy problem test to students who had been selected as research subjects. In the last stage, the researcher conducted in-depth interviews with research subjects to explore their mathematical thinking activities.

The collected data is then analysed using qualitative data analysis techniques from Creswell (2014) which contain three stages, namely: data reduction, data interpretation, and conclusion. Data reduction is the selection of data based on suitability with the research objectives. Meanwhile, data that are not in line with the research objectives are considered as findings. The data that has been reduced is then described as it is according to the results of research in the field. The last step is to make a conclusion based on the results of data interpretation. In this case, data analysis about students' mathematical thinking processes is based on several stages: Specialising, Generalising, Conjecturing, and Convincing.

RESULTS AND DISCUSSION

Climber students do not give up easily when they get problems that require mathematical and analytical thinking skills. They continue to try to understand every piece of information and questions presented in the questions. Students with this type still try to solve problems that other students think are quite difficult. Meanwhile, *camper* students seem to have made less effort in identifying every information presented in the questions so that the answers given are not appropriate. Camper students are quickly satisfied with the results obtained, so they do not check again. Then students with *quitter* type work on the problem without any effort so that they are stuck as long as they are finished. *Quitter* type students do not identify problems first but immediately give answers that are not in accordance with the questions in the question. In general, the percentage of students who are prospective elementary school teachers is reviewed from the type of *adversity quotient* presented in Figure 2.

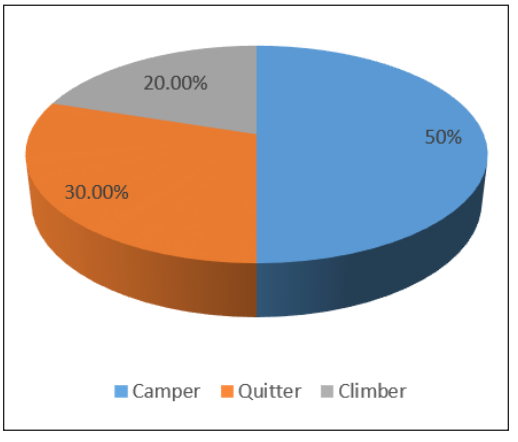


Figure 2. Adversity Quotient test results

Figure 2 shows that there are more students with *camper* and *quitter* types than *climber* type students. The researcher randomly selected student representatives from each type to be used as research subjects. The researcher uses a pseudonym to explain the results of the exploration of each research subject.

Climber Type Students

The findings reveal nuanced differences across AQ types that extend beyond initial expectations. Climber-type students not only demonstrated persistence in problem solving but also displayed positive affective behaviours such as enthusiasm, curiosity, and willingness to explain their reasoning to peers. This aligns with international findings that suggest high-AQ students are more likely to embrace productive struggles in mathematics.

Aldo is a pseudonym for students who are researching subjects with a climber type. He gave the correct answer to the question he was working on. Aldo answered the question by identifying each information contained in the question. The identification carried out is to determine how much the number of clothing production increases every year. Aldo said that the increase in the number of productions every year is 200 clothes. The last information presented in the question is the amount of production in 2020, while what is asked is 2024, so the difference is 4 years.

Thus, Aldo can conduct an analysis to calculate the number of clothes produced over 4 years is 800 clothes. Furthermore, Aldo used the information known in the question which stated that the production in 2020 was 4,400 clothes and then added it up with 800 clothes so that the production in 2024 was 5,200 clothes. This was not written directly by Aldo but was conveyed during an in-depth interview between the researcher (R) and the subject Aldo (SA) to him, as shown in the following interview snippet:

R : Why can 4,400 be added by 800? Where can you get 800 from?

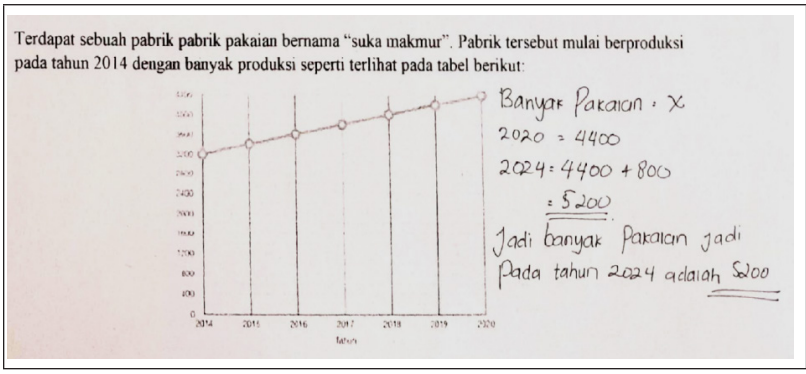
SA : Many clothing productions in 2024 are not yet known, but in 2020 it is already known, namely 4,400 clothes. Because the increase every year is 200 clothes, to find out the increase in production from 2020 to 2024 is $200 \times 4 = 800$, I multiply by 4 because from 2020 to 2024 there is a difference of 4 years. After that, to find out the number of productions in 2024, I just need to add 4,400 by 800 so that 5,200 clothes are obtained

The interview was conducted in depth to Aldo as a subject with the Climber type. The interview is based on the results of a written test that has been done by the Climber subject. The results of the subject's work are presented in Figure 3.

From the results of the exploration to the subject, Aldo is known that he carried out thinking activities for *the specialising* stage by identifying the information presented about the increase in the number of clothes produced every year, which is as many as 200 clothes. Then he *generalizes* by determining the amount of production between 2020 and 2024. The *conjecturing* stage is carried out by mentioning the number of fabrics produced into clothing in 2024 as many as 5,200. The last is the *convincing* stage by providing an explanation of the results of making conjectures.

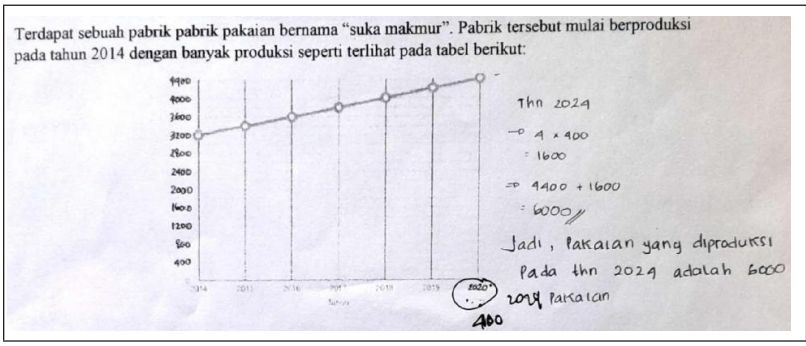
Camper Type Students

Camper-type students, while making an effort to engage with problems, revealed



There is a clothing factory called "Suka Makmur." The factory started producing clothes in 2014 with a lot of production as in the following table:
Lots of clothes = x
2020 = 4400
2024 = 4400 + 800
= 5200
So, the number of clothes in 2024 is 5200

Figure 3. Climber type students' work



There is a clothing factory called "Suka Makmur". The factory started producing clothes in 2014 with a lot of production as in the following table:
2024
4 × 4400 = 1600
4400 + 1600 = 6000

So, the clothes produced in 2024 are 6000 clothes

Figure 4. Camper type students' work

tendencies toward cognitive bias, particularly in misinterpreting graphical data. Their pseudo-generalisations stemmed from overreliance on surface features of problems rather than deeper structural reasoning. This suggests that interventions for camper-type students should emphasise critical reading of mathematical representations and guided reflection on error analysis.

Bety is a pseudonym for students with *a camper type.* Bety mentioned that the "Suka Makmur" factory produced clothes in 2014, 2015, 2016, 2017, 2018, 2019, and 2020. Every year the factory experiences an increase of 400 clothes, then the difference from 2020 to 2024 is four years so that the production of clothes in a period of 4 years is 1,600 clothes. Then, to determine the number of clothes in 2024, Bety added up the number of clothes produced from 2020 to 2024 so that 6,000 clothes were obtained. The results of the *camper* type of subject work can be seen in Figure 4.

From the results of the work of the subject Bety, it is known that he carries out *specialising* activities by identifying the increase in clothing production every year. From the results of the identification, information was obtained that the increase in the number of clothing production every year was 400 clothes. Then, for the *generalising* stage, it is carried out

by determining the amount of clothing production between 2020 and 2024. From the *results of generalising*, it was obtained that a lot of clothing production from 2020 to 2024 is 1,600 clothes, so the *conjecture* formed by Bety is a lot of clothing production in 2024 as many as 6000 clothes.

This was conveyed by Bety during an interview, but the explanation conveyed was not appropriate because he mentioned that the increase in production every year was 400 clothes instead of 200 clothes. This happened because Bety was not aware that he was not careful in reading the graph presented in the test questions. The result of Bety's work is the same as another student who is also a camper type. The student is named Norma because she also gave an answer of 6,000 clothes, even though the correct answer was 5,200 clothes. The inaccuracy of students in reading graphs can be categorised as *pseudo-generalisation*. The term *pseudogeneralisation* is in accordance with the opinion of Dumitrascu (2017) which states that the process of generalisation in mathematical thinking can be carried out pseudo-generalisation. In this case, the subject makes generalisations based on incorrect data.

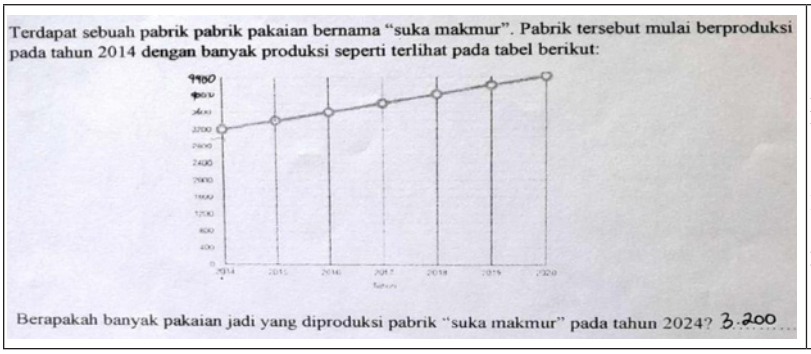
Quitter Type Students

Quitter-type students' disengagement underscores the urgent need for targeted scaffolding strategies. Their responses reveal limited self-efficacy and a lack of resilience, which may be linked to previous negative experiences in learning mathematics. Embedding growth mindset training, affective support, and incremental task design into teacher education programmes may help mitigate these tendencies.

Cindy is a pseudonym for Quitter-type students who are the subject of research. Cindy only identified the problem by looking at the number of clothes produced in 2014 because she assumed that the number of clothes produced in 2024 would be the same as in 2014, which was 3,200 clothes. Thus, it can be seen that Cindy did not do the *generalising* and *convincing stage,* because she only gave answers in the form of assumptions based on the information written in the question. Cindy did not conduct a more in-depth analysis of each information presented in the question. Cindy's mistakes in doing the test can occur because she is not able to identify all the information presented in the form of a graph. The results of Cindy's work are presented in Figure 5.

From the results of the exploration to the subject, Cyndi shows that he has no effort to understand every piece of information presented in the question. As a result, not all stages of mathematical thinking activities are carried out by Cyndi. Then the answers obtained from the results of solving the problem are not in accordance with the questions contained in the questions. This can be seen from the results of an interview conducted by the researcher (R) with SC (Cyndi's subject).

R : Where can you get 3200 for clothing production in 2024?
SC : I equate it with the number of productions in 2014, ma'am.
R : Why are they equated?
SC : Because my assumption is the same between 2014 and 2024



There is a clothing factory called "Suka Makmur". The factory started producing clothes in 2014 with a lot of production as in the following table:

How many apparel will the "Suka Makmur" factory produce in 2024? 3.200

Figure 5. Quitter type students' work

Based on the analysis of the results of student work on each type *of adversity quotient*, differences in mathematical thinking activities were obtained. These differences are presented in Table 1.

Table 1
Student thinking activities

Observed Variables	Type	Mathematical Thinking	Indicators	Descriptor
Adversity Quotient	Climber	Specialising	Identify the information presented in the question	Mentioning the increase in clothing production every year
		Generalising	Determining the settlement steps to make a guess	Clothing production within four years as many as 800 clothes
		Conjecturing	Giving a conjecture	The number of clothing production in 2024 will be 5,200 clothes
		Convincing	Providing an explanation of the results of the allegations	The explanation conveyed was precise and appropriate.
	Camper	Specialising	Identify the information presented in the question	Observing the increase in many clothing productions every year
		Generalising	Determining the settlement steps to make a guess	Clothing production within four years as many as 1,600 clothes
		Conjecturing	Giving a conjecture	The number of clothing production in 2024 will be 6,000 clothes
		Convincing	Providing an explanation of the results of the allegations	The explanation presented was incorrect because there was an error in identifying the data at the generalisation stage
	Quitter	Specialising	Identify the information presented in the question	Only focus on the production of clothing in 2014
		Generalising	Determining the settlement steps to make a guess	Not doing
		Conjecturing	Giving a conjecture	Clothing production in 2024 is the same as production in 2014
		Convincing	Providing an explanation of the results of the allegations	Not doing

From Table 1, it is known that not all students from each type of adversity quotient do the stages of mathematical thinking. The inability of students to do mathematical thinking stages is due to students not being used to solving numeracy problems related to reading graphs. The *specialising* stage carried out by Aldo and Bety is in accordance with what was conveyed by Putri et al. (2020) that in *specialising* contains three activities, namely: students can compile details of the information known and asked in the question; students can understand concepts based on past experience to solve problems; students can find examples related to some information on the problem being solved.

Generalisation is an activity to determine information that applies in general. Generalisation is defined as a statement that is considered correct for all categories of objects in the question (Dumitrascu, 2017). Generalisation can also be interpreted as the relationship between objects in a set and subsets. In other words, generalisation is expanding the object of the mathematical set being worked on by identifying the general information in the set (Jeannotte & Kieran, 2017). Problem identification in mathematical thinking can also be characterised by reading the question carefully, determining relevant ideas, classifying ideas into several objects, representing them in the form of notation or symbols (Faizah et al., 2020). In this case, generalisation is manifested by the ability of prospective elementary school teacher students when determining a large increase in clothing production in 2024 based on the information available on the graph.

Generalisation is closely related to conjectures because generalisation is a way to formulate conjectures (Santos et al., 2022). Conjecture is the process of formulating a claim accompanied by complete evidence. The evidence of a conjecture is built through a mathematical thought process to form a valid argument (Pedemonte, 2008; Sa'adah et al., 2023). Furthermore, conjecture is a mathematical statement that is hypothetical, that is, the statement has the potential to be true because it is constructed by students using their own knowledge based on the information contained in the problems that have been worked on (Astawa et al., 2018). In this case, conjecture is an allegation in the form of a statement of the research subject based on the results of generalisation.

The statements given by the subject can be true or false. The results of the exploration to Aldo's subject show that the conjecture given is true so that the answer given is also correct. Meanwhile, the subject Bety gave a wrong guess because he made a mistake when identifying the information written in the question. Meanwhile, *convincing* is the stage of providing an explanation of the conjecture that has been given. In this case, not all types of adversity quotients carry out the stages of mathematical thinking because of the limitations of students in identifying every information presented in the problem so that they do not do the convincing stage.

The implications of these findings are manifold. For teacher education, it is essential to design curricula that not

only teach mathematical content but also explicitly nurture resilience and perseverance. Policymakers can also draw from these insights to align national curricula, such as *Merdeka Belajar* and AKM, with initiatives that integrate non-cognitive skill development. From a research perspective, the integration of AQ and mathematical thinking offers a promising interdisciplinary framework for advancing mathematics education scholarships.

Case Examples and Classroom Narrative

To better illustrate how AQ manifests in real classrooms, consider a prospective teacher facing a class of students struggling with a numeracy problem involving fractions. A quitter-type teacher may avoid delving deeper into the concept, offering superficial explanations and quickly moving on to avoid discomfort. A camper-type teacher might attempt a solution but rely heavily on procedural drills, failing to address underlying misconceptions. In contrast, a climber-type teacher would persist, experimenting with visual aids, encouraging peer discussion, and re-explaining concepts until students grasp the material. These narratives highlight the direct pedagogical consequences of AQ in shaping classroom dynamics and student learning outcomes.

Another example involves graph interpretation tasks, similar to those used in this study. When confronted with a graph depicting production increases, quitter-type students tend to default to guesses, while camper-type students misread the increments. The climber-type students, however, systematically analysed the trend and cross-checked their conjectures, ultimately producing accurate answers. Embedding such case studies into teacher training can help prospective teachers self-reflect on their own AQ tendencies and adopt strategies to strengthen persistence.

Comparative international research underscores the urgency of strengthening numeracy and resilience. In countries such as Finland, Singapore, and Japan, numeracy education is tightly linked with practices that encourage persistence and problem-solving. Finnish schools integrate collaborative problem-solving tasks, which not only deepen numeracy skills but also build adaptive social-emotional competencies. In Singapore, the 'productive struggle' approach is institutionalized, where students are deliberately exposed to challenging problems with structured teacher support. This pedagogical culture normalizes mistakes as opportunities for growth and builds both cognitive and non-cognitive resilience.

Japan's lesson study model provides another lens through which AQ can be nurtured. Teachers collaboratively plan, implement, and reflect on lessons, often focusing on difficult problems that stimulate deep thinking. Such collective reflection fosters not only teacher professional growth but also resilience in navigating challenging classroom dynamics. By drawing lessons from these global models, Indonesian teacher education can integrate best practices to enhance AQ development among future elementary school teachers.

In the era of digital transformation, technology can play a critical role in supporting AQ development. Adaptive learning platforms can personalize numeracy challenges according to students' persistence levels, providing gradual scaffolding for those who tend to give up early. Gamification elements, such as badges for persistence or progress milestones, can encourage sustained engagement. Augmented reality (AR) and virtual reality (VR) tools may also immerse students in authentic problem-solving environments where resilience is naturally demanded.

For teacher education, incorporating digital tools into numeracy pedagogy courses can simulate real-life adversity. For example, simulation-based platforms can create scenarios where teachers must respond to student errors, classroom disruptions, or conceptual misconceptions. These simulations can serve as safe practice grounds for building AQ, as they allow repeated attempts, feedback, and reflection. Thus, integrating technology not only strengthens numeracy teaching but also cultivates adaptability and resilience among future teachers.

Comparing international education policies provides valuable lessons for embedding AQ in teacher education. In Australia, professional standards for teachers emphasise resilience and adaptability as part of graduate attributes. In the United States, social-emotional learning frameworks highlight perseverance and grit as essential for student success, indirectly influencing teacher preparation. Meanwhile, countries like Finland integrate resilience training into teacher induction programmes, ensuring that novice teachers develop coping strategies during their first years in the profession.

Indonesia's current reforms under Merdeka Belajar can draw from these global precedents. Explicitly positioning AQ within national teacher competency standards would not only strengthen teacher preparation but also align with the country's broader educational vision. Embedding AQ into teacher certification, professional development, and school evaluation systems could institutionalize resilience as a key quality for both teachers and students. By doing so, Indonesia would contribute to global conversations on education reform while addressing local challenges in numeracy teaching.

Looking ahead, teacher education must evolve to prepare future educators who are not only content experts but also adaptive, resilient, and globally aware. Future-oriented teacher education models emphasise interdisciplinary integration, digital literacy, and lifelong learning dispositions. Programmes should be designed to expose prospective teachers to complex, real-world problems that require persistence, collaboration, and innovation to solve. By embedding these experiences early in teacher preparation, institutions can ensure that future teachers enter the profession with both strong mathematical competencies and the resilience to navigate the uncertainties of modern classrooms.

Several emerging models illustrate these principles. For instance, transdisciplinary problem-based learning (PBL) approaches integrating numeracy with science,

technology, and social studies, encouraging students to apply mathematical reasoning across contexts. In such environments, adversity is inevitable, and students must cultivate AQ to manage ambiguity and complexity. Another model involves digital micro-credentialing, where prospective teachers earn badges for demonstrating resilience in teaching practicums, reflective practice, or mastery of AQ-related competencies. These innovations suggest that AQ can be operationalised as a measurable outcome in teacher education.

To ensure the practical impact of this research, comprehensive recommendations are outlined across multiple levels. For teacher educators, AQ-focused reflective tasks should be mandatory in numeracy courses, supported by continuous feedback mechanisms. For policymakers, national teacher standards should explicitly integrate non-cognitive skills, with AQ identified as a measurable competency. For curriculum designers, numeracy modules should include open-ended problems, case studies, and group projects that encourage persistence and adaptive reasoning. At the school level, professional learning communities (PLCs) can be leveraged to create peer support systems where teachers share strategies for overcoming numeracy teaching challenges. Additionally, assessment reforms should recognise not only mastery of content but also perseverance in approaching complex problems. Collectively, these recommendations provide a roadmap for embedding AQ into Indonesia's broader educational reform agenda.

CONCLUSION

Adversity Quotient is closely related to mathematical thinking skills. There are three types of Adversity Quotient for prospective elementary school teachers in solving Numeracy problems. The mathematical thinking activity of each type of Adversity Quotient is explored through four stages, namely specialising, generalising, conjecturing, and convincing. Climber type teacher candidates do all four stages of mathematical thinking correctly when solving numerical problems. Camper type students also carry out the four stages of mathematical thinking, but at the generalising stage, students are not thorough. This is because students are unable to identify the data presented in the form of graphs so that camper type students experience *pseudo-generalisation*. While *quitter* type students only do *the specialising* and *conjecturing stages,* quitter type students do not do the generalising and convincing stages because of their limited ability to identify every information presented. From the results of the study, it was found that quitter type students did not do all stages of mathematical thinking because students did not identify every information presented in the form of graphs and did not often practice solving numeracy problems.

Practical implications include embedding AQ development into teacher preparation curricula through problem-based learning, reflective journals, and collaborative teaching simulations. Future research could adopt longitudinal designs to track AQ development over time, as well

as cross-cultural comparisons to investigate the universality of AQ's impact on numeracy problem solving. Furthermore, experimental studies test specific pedagogical interventions—such as metacognitive training or growth mindset workshops—could provide actionable strategies for educators. Ultimately, preparing resilient, reflective, and numerate teachers will contribute significantly to improving mathematical literacy and lifelong learning outcomes in Indonesia and beyond. By expanding the scope of this study, the article now offers both theoretical enrichment and practical pathways for strengthening teacher education in the 21st century.

In conclusion, the integration of Adversity Quotient into teacher education is not only a theoretical aspiration but also a practical necessity. As the global landscape of education becomes more uncertain and complex, resilience and persistence emerge as critical attributes for both teachers and students. This study contributes by linking AQ with mathematical thinking, offering evidence that resilience directly impacts how future teachers engage with numeracy problems. Expanding this discourse can inspire innovations in pedagogy, curriculum, and policy that ensure education remains relevant, equitable, and empowering for all learners.

ACKNOWLEDGEMENT

This research, titled "Exploring the Adversity Quotient (AQ) of Future Elementary School Teachers in Numeracy Problem Solving" was conducted with funding from the Indonesian Collaborative Research grant (State Universities with Legal Entity Status) and the Institute for Research and Community Service of Universitas Negeri Malang, under contract number 14.4.61/UN32.14.1/LT/2025. We extend our deepest gratitude to the schools, teachers, and students who participated in this study; their cooperation and contributions were invaluable to the research success.

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