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The role of adversity quotient (AQ) for successful mathematics learning

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ABSTRACT

This study aims to explore the role of adversity quotient (AQ) in the success of mathematics learning. AQ refers to an individual's ability to survive and overcome difficulties in learning, which is particularly relevant in the context of mathematics which is often considered a challenging subject. This article examines the history and development of the concept of AQ, how it differs from other intelligences such as IQ and EQ, as well as AQ development strategies to improve achievement in mathematics. This study uses a literature review method by analyzing academic literature in the last 10-15 years. Challenges include the complexity of mathematical concepts, misunderstandings, anxiety, lack of motivation, diverse learning styles, a less supportive learning environment, and different starting abilities. AQ, which refers to a person's ability to persevere in the face of adversity, plays a crucial role in helping students overcome these challenges. This research discusses the history and development of the concept of AQ, its dimensions, its differences with other intelligences such as IQ and EQ, and its important role in overcoming the challenges of mathematics learning. The results of the study show that AQ contributes significantly to improving students' motivation, learning resilience, and problem-solving skills in mathematics. This study provides recommendations for educators in creating a supportive learning environment as well as strategies to improve students' AQ.

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1. INTRODUCTION

Mathematics stands as one of the most formidable academic challenges for a significant portion of the student population, with learners grappling with a multitude of obstacles in this field. The intricate nature of mathematical concepts often poses a substantial cognitive challenge, requiring students to grasp and manipulate complex, abstract ideas that may seem far removed from their everyday experiences. This conceptual complexity is frequently compounded by deeply ingrained misconceptions, which can obstruct the learning process and hinder the development of a solid mathematical foundation. Additionally, mathematics anxiety represents a significant affective barrier for many learners, manifesting as fear, apprehension, or unease when confronted with mathematical tasks, potentially impeding performance and discouraging engagement with the subject. Equally challenging is the issue of motivation and persistence in mathematical studies, with many students struggling to maintain enthusiasm and dedication when faced with the rigorous demands of mathematical learning, which collectively contribute to making mathematics a particularly demanding subject (Huijuan 2009). These challenges can hinder successful mathematics learning and affect students' overall academic achievement.

The concept of Adversity Quotient (AQ), pioneered by Paul G. Stoltz, encapsulates an individual's capacity to endure hardships and surmount obstacles effectively. Recognized as a critical factor in navigating life's

myriad challenges, AQ holds particular significance in educational settings. Within the realm of mathematics education, AQ assumes a pivotal role, empowering students to confront and overcome the diverse hurdles they encounter in their learning journey. This resilience-focused construct not only aids learners in persevering through the complexities of mathematical concepts but also contributes substantially to their ultimate academic success. By fostering the ability to withstand setbacks and maintain motivation in the face of difficulties, AQ equips students with the mental fortitude necessary to tackle the rigorous demands of mathematics, thereby enhancing their potential for achievement in this challenging field (Stoltz 1997).

Previous research has shown a positive relationship between AQ and mathematics learning achievement. Safi'i et al. (2021) found that Adversity Quotient (AQ) and achievement motivation serve as crucial determinants of academic performance among secondary school students. These two factors have been shown to exert a significant influence on student's educational outcomes, highlighting their importance in the scholastic environment. The study suggests that students who possess higher levels of AQ - the ability to persevere through challenges - coupled with a strong drive to achieve, tend to demonstrate superior academic results. This correlation underscores the vital role that both resilience in the face of adversity and intrinsic motivation play in shaping students' educational success, particularly at the secondary school level. Huijuan's (2009) studies have demonstrated a notable correlation between students' Adversity Quotient (AQ) levels and their mathematical performance. The research indicates that learners possessing higher AQ scores generally attain superior academic results in mathematics when compared to their peers with lower AQ. This finding suggests that the capacity to effectively manage challenges and setbacks, as measured by AQ, plays a crucial role in mathematical achievement. Students with elevated AQ levels appear better equipped to navigate the complexities and obstacles inherent in mathematics education, leading to improved academic outcomes in this subject area. This relationship between AQ and mathematical success underscores the importance of fostering resilience and perseverance in students as a means of enhancing their mathematical proficiency and overall academic performance.

Previous studies have shown that AQ has a positive correlation with math learning achievement. However, there is still a gap in research related to how the application of AQ improvement strategies can be integrated in mathematics learning. Therefore, this study seeks to examine the concept of AQ, its dimensions, and implementation strategies in the educational environment. This research aims to dig deeper into the concept of AQ, its dimensions, its differences with other intelligences, its important role in overcoming the challenges of mathematics learning, and strategies to develop it. More specifically, this study will discuss the history and development of the concept of AQ, analyze its main dimensions, distinguish AQ from other intelligences such as IQ and EQ, and identify specific challenges in mathematics learning that can be overcome by developing AQ. We will also discuss various strategies to improve AQ in maths learning, such as creating a supportive learning environment, using a student-centered learning approach, promoting a growth mindset, providing constructive feedback and emotional support, and integrating specific activities to practice AQ skills.

A thorough comprehension of Adversity Quotient (AQ) has the potential to significantly impact the landscape of mathematics education. By equipping educators, parents, and students with insights into AQ, this research aims to bolster efforts in enhancing mathematical persistence and achievement. The findings are expected to serve as a springboard for future investigations, particularly in exploring the development of AQ within the context of mathematics learning. Such research could yield far-reaching implications, not only for academic success but also for students' overall life outcomes. By illuminating the role of AQ in mathematical proficiency, this study may pave the way for innovative teaching strategies, targeted interventions, and supportive environments that foster resilience in the face of mathematical challenges. Ultimately, this deeper understanding of AQ could contribute to a more holistic approach to education, empowering students to overcome obstacles both in their academic pursuits and in their broader life experiences.

2. METHOD

When conducting a literature review on "The role of adversity quotient (AQ) in successful mathematics learning," the first step is to identify the main keywords such as adversity quotient, mathematics learning, and academic success. A comprehensive literature search will be conducted using electronic databases such as Google Scholar, focusing on peer-reviewed academic journals, textbooks, and research reports published in the last 10-15 years. The selected literature will be analyzed systematically to identify key themes, methodologies employed in previous studies, and significant findings and conclusions. Specifically, the analysis will include a detailed description of the data collection process, outlining the criteria for selecting literature, including inclusion and exclusion criteria to ensure the relevance and quality of the sources. Additionally, the review will evaluate the research designs used in the studies, such as qualitative, quantitative, or mixed-method approaches, discussing their appropriateness for investigating AQ in mathematics learning. Information from various sources will be synthesized to form a theoretical framework that encompasses the definition of AQ, the theories underlying it, and its relationship to success in mathematics learning.

This study will also seek to identify gaps in existing research and develop a conceptual framework linking AQ to successful mathematics learning. The results of the study will be organized in a logical structure, beginning with an introduction that explains the background and significance of the topic, followed by a discussion of key concepts, a review of previous research, and concluding with implications for further research. This process will culminate in a concise yet comprehensive literature review, providing a robust theoretical basis for empirical research on the role of AQ in successful mathematics learning. By detailing the methodology and analysis, this study aims to enhance the understanding of how AQ influences mathematics learning outcomes and to inform future educational practices.

3. RESULTS AND DISCUSSION

3.1. History and Development of the AQ Concept

The genesis of the Adversity Quotient (AQ) concept, also known as adversity intelligence, can be traced back to the early 1990s and the work of Dr. Paul G. Stoltz, a psychologist with a keen interest in human resilience. During his tenure as a consultant and speaker for various corporations, Stoltz made a compelling observation: certain individuals demonstrated a markedly superior ability to confront and overcome adversity and challenges compared to their peers. This intriguing disparity in resilience sparked Stoltz's curiosity, prompting him to embark on an extensive research journey aimed at unraveling the underlying factors that contribute to success in the face of adversity. Drawing inspiration from the well-established concepts of Intelligence Quotient (IQ) and Emotional Quotient (EQ), Stoltz sought to identify and quantify this distinct form of intelligence that seemed to play a crucial role in determining an individual's capacity to navigate life's difficulties successfully (Stoltz 1997).

Following an extensive period of research involving data collection from a vast number of individuals, Stoltz culminated his work with the publication of "Adversity Quotient: Turning Obstacles into Opportunities." This seminal book introduced the concept of AQ to a broader audience, defining it as an individual's capacity to confront and surmount challenges or adversities. In this work, Stoltz delineated three distinct categories of individual responses to difficulties: "quitters," who abandon their efforts in the face of obstacles; "campers," who become complacent with minimal progress; and "climbers," who persistently strive to overcome challenges. This categorization provided a framework for understanding varying levels of resilience and perseverance among individuals, offering insights into why some people continue to push forward in the face of adversity while others falter or settle for less than their full potential (Stoltz 1997).

In 2000, Stoltz advanced his work on Adversity Quotient by introducing a quantitative measurement tool called the Adversity Response Profile (ARP). This instrument was designed to assess an individual's AQ level through four key dimensions, collectively known by the acronym CORE: Control, Ownership, Reach, and Endurance. The Control dimension evaluates the degree to which a person believes they can influence challenging situations. Ownership measures how much an individual acknowledges the ramifications of a difficulty. Reach assesses the perceived extent to which adversity impacts other areas of one's life. Finally, Endurance gauges an individual's perception of the duration of both the difficulty itself and its underlying causes. This comprehensive framework provided a structured approach to understanding and quantifying a person's resilience and response to adversity, offering valuable insights into individual coping mechanisms and potential areas for personal growth (Stoltz 2000).

As Stoltz's work on Adversity Quotient (AQ) evolved, he expanded its application to diverse life domains. In 2000, he released "Adversity Quotient at Work," a book that focused on the relevance of AQ in professional settings and leadership development. This publication elucidated how AQ could be leveraged by both individuals and organizations to navigate workplace challenges, adapt to change, and manage uncertainty effectively. A key contribution of this work was the introduction of the LEAD Sequence, a methodical framework designed to enhance AQ. This four-step approach - Listen, Explore, Analyze, and Do - provided a structured process for individuals to assess situations, gain insights, and take action to improve their resilience in the face of adversity. Stoltz's continued research and practical applications significantly broadened the scope and impact of AQ theory in professional and personal development contexts (Stoltz 2000).

Many fields, including education, business, and personal development, have widely adopted and applied the AQ concept. Education uses AQ to foster students' resilience and persistence in learning (Juwita, Roemintoyo, and Usodo 2020). In the business world, AQ is considered one of the key factors in effective leadership and the ability to adapt to change. Researchers also continue to explore factors that influence AQ, such as parenting (Canivel 2010), spirituality, and emotional intelligence (Matore, Khairani, and Razak 2015), as well as ways to improve it, such as through AQ-based training and interventions (Venkatesh and Shivaranjani 2016).

With a better understanding of AQ, it is hoped that more people will be able to develop mental resilience and achieve success in facing various life challenges. AQ is believed to be an important complement to IQ and EQ in determining a person's success, both in personal and professional life (Stoltz 1997).

3.2. AQ Dimensions

The Adversity Quotient (AQ) concept developed by Paul G. Stoltz consists of four main dimensions known by the acronym CORE. The following is a detailed description of each AQ dimension:

1. Control: ontrol, as a dimension of Adversity Quotient (AQ), encapsulates an individual's perceived ability to manage and influence challenging situations. This concept measures the degree to which a person believes they can exert control over the difficulties they encounter. It reflects an individual's sense of agency and empowerment when confronted with adversity, indicating their confidence in their capacity to shape outcomes despite obstacles. High levels of control suggest that a person views challenges as manageable and within their sphere of influence, leading to proactive problem-solving approaches. Conversely, lower levels of control may result in feelings of helplessness or passivity in the face of adversity. This dimension of AQ plays a crucial role in determining how individuals approach and respond to challenges, ultimately influencing their resilience and success in overcoming obstacles. (Stoltz 1997). Individuals with high AQ tend to have greater control over the events in their lives, while individuals with low AQ feel that they have little or no control (Stoltz 2000). Research shows that higher perceived control correlates with better performance, better mental health, and greater adaptability (Matore et al. 2015).
2. Ownership: The ownership dimension of Adversity Quotient (AQ) measures an individual's inclination to recognize and take responsibility for the consequences of difficulties, regardless of their origin. This aspect of AQ significantly influences how people approach and respond to challenges. Individuals with high ownership tend to adopt a proactive stance, focusing on solutions and personal actions to improve situations rather than fixating on causes or blame. They often view adversities as opportunities for growth and learning. In contrast, those with lower ownership levels are more likely to attribute their problems to external factors or other people, potentially leading to a more passive approach and feelings of helplessness. This tendency to externalize responsibility can hinder effective problem-solving and personal development. The ownership dimension thus plays a crucial role in shaping an individual's resilience, ability to learn from experiences, and overall effectiveness in navigating life's challenges, making it a key component in understanding and developing one's capacity to overcome adversity. Research shows that individuals who take responsibility for their actions tend to be more successful in overcoming difficulties and achieving their goals (Venkatesh and Shivaranjani 2016).
3. Reach: Reach indicates the extent to which difficulties will affect other aspects of a person's life (Stoltz 1997). Individuals possessing high Adversity Quotient (AQ) demonstrate a remarkable ability to compartmentalize challenges, effectively containing the impact of difficulties to specific areas of their lives. This skill allows them to maintain focus and productivity in other domains, preserving their overall well-being and functionality. In contrast, those with lower AQ levels often struggle to confine the effects of adversity, allowing problems to permeate various aspects of their lives indiscriminately. This tendency can lead to a domino effect, where a setback in one area cascades into others, potentially affecting relationships, work performance, and personal well-being. The capacity to limit the reach of difficulties is a crucial component of resilience, enabling high-AQ individuals to navigate challenges more effectively while maintaining balance and perspective in their lives. This ability to isolate problems and prevent them from overshadowing unrelated aspects of life contributes significantly to overall resilience and adaptability in the face of adversity (Stoltz 2000). Research shows that the ability to limit the range of adversity is correlated with better emotional well-being and a greater ability to cope with stress (Canivel 2010).
4. Endurance: Endurance is defined as a person's perception of how long difficulties and their causes will last (Stoltz 1997). Individuals with high Adversity Quotient (AQ) typically perceive difficulties and their underlying causes as transient phenomena, viewing challenges as temporary hurdles rather than insurmountable obstacles. This optimistic perspective enables them to maintain hope and motivation, fostering a belief that their efforts can lead to positive change over time. In contrast, those with lower AQ often regard challenges and their root causes as enduring or even permanent fixtures in their lives. This pessimistic outlook can lead to feelings of helplessness and resignation, potentially undermining their motivation to seek solutions or persevere through hardships. The ability to view adversity as a temporary state significantly influences an individual's resilience and problem-solving approach. High-AQ individuals are more likely to engage in proactive coping strategies, maintaining confidence in their capacity to overcome challenges, while those with lower AQ may struggle to envision a future beyond their current difficulties, potentially leading to decreased effort and persistence in the face of adversity (Stoltz 2000). Research shows that individuals who view difficulties as temporary tend to be more persistent in facing challenges and recover more quickly from setbacks (Venkatesh and Shivaranjani 2016).

The four dimensions of Adversity Quotient (AQ) - Control, Ownership, Reach, and Endurance - function as interconnected components that collectively shape an individual's capacity to confront and surmount challenges. These dimensions work in concert to determine one's overall resilience and adaptability in the face of adversity. By cultivating awareness and actively developing each of these dimensions, individuals can enhance their AQ, thereby bolstering their ability to navigate life's myriad difficulties with greater effectiveness and resilience. The

interplay between these dimensions creates a complex framework for understanding human responses to adversity, suggesting that improvement in one area may have ripple effects across the others. However, the intricate dynamics of these dimensions and their contextualized interactions remain areas ripe for further exploration. Additional research is crucial to elucidate how these dimensions operate and influence each other across various situations and environments. Such investigations could provide valuable insights into tailoring interventions and strategies for AQ development, potentially leading to more targeted and effective approaches for enhancing individual resilience in diverse life contexts.

3.3. Difference between AQ, IQ, and EQ

The Adversity Quotient (AQ), Intelligence Quotient (IQ), and Emotional Quotient (EQ) represent distinct yet interrelated facets of human capability and potential. While IQ measures cognitive abilities such as logical reasoning, problem-solving, and memory, EQ assesses one's capacity to recognize, understand, and manage emotions in oneself and others. AQ, in contrast, gauges an individual's resilience and ability to persevere through challenges. These three quotients work in tandem to provide a more comprehensive picture of a person's overall competence and adaptability. IQ might determine how quickly someone can grasp complex concepts, EQ influences how well they navigate social interactions and personal relationships, and AQ predicts how effectively they can overcome obstacles and setbacks. Together, these measures offer a multidimensional view of human potential, suggesting that success and personal fulfillment depend on a combination of intellectual prowess, emotional intelligence, and resilience in the face of adversity. The following is a description of the differences between AQ, IQ, and EQ:

3.3.1. Definition

Intelligence Quotient (IQ) is a measure that assesses an individual's cognitive capabilities, encompassing a range of mental skills crucial for academic and professional success. It primarily evaluates a person's capacity for logical thinking, problem-solving, and comprehension of abstract ideas. IQ tests typically gauge abilities such as spatial reasoning, mathematical aptitude, verbal comprehension, and memory. These assessments aim to quantify an individual's intellectual potential compared to the general population. High IQ scores often correlate with enhanced academic performance, quicker learning rates, and proficiency in tasks requiring complex cognitive processing. However, it's important to note that IQ represents just one aspect of human intelligence and does not account for other crucial factors such as creativity, emotional intelligence, or practical skills. While IQ remains a valuable indicator of certain cognitive abilities, it is increasingly viewed as part of a broader spectrum of intelligences that collectively contribute to an individual's overall capability and potential for success (Wechsler 1944).

Emotional Quotient (EQ), also known as emotional intelligence, encompasses an individual's capacity to identify, comprehend, and effectively manage emotions, both in themselves and in others. This multifaceted concept involves several key components: self-awareness, the ability to recognize and understand one's own emotional states; self-regulation, the skill of managing and appropriately expressing one's emotions; empathy, the capacity to perceive and understand the emotions of others; and social skills, the ability to navigate interpersonal relationships effectively. High EQ is associated with enhanced communication skills, better conflict resolution abilities, improved leadership capabilities, and more satisfying personal relationships. Individuals with well-developed emotional intelligence tend to be more adaptable in various social situations, demonstrate greater resilience in the face of stress, and often excel in roles requiring strong interpersonal skills. Unlike IQ, which is largely considered static, EQ can be developed and improved over time through self-reflection, practice, and conscious effort, making it a valuable area for personal and professional growth (Goleman 2020).

Adversity Quotient (AQ) measures an individual's capacity to confront and surmount challenges or difficulties in life. This concept, developed by Paul G. Stoltz, assesses a person's resilience and tenacity when faced with adversity. AQ encompasses the ability to persevere through obstacles, maintain focus and motivation during trying times, and emerge stronger from setbacks. Individuals with high AQ typically demonstrate greater adaptability, viewing challenges as opportunities for growth rather than insurmountable barriers. They tend to approach problems with a proactive mindset, seeking solutions and maintaining optimism even in the face of significant difficulties. AQ is composed of four key dimensions: control, ownership, reach, and endurance, which collectively determine how effectively a person responds to and navigates through adversity. Unlike IQ, which is largely innate, AQ can be developed and improved over time through conscious effort and practice, making it a valuable skill for personal and professional success in an increasingly complex and challenging world. (Stoltz 1997).

3.3.2. Focus

The concepts of Intelligence Quotient (IQ), Emotional Quotient (EQ), and Adversity Quotient (AQ) represent distinct yet complementary aspects of human capability. IQ primarily assesses cognitive and intellectual abilities, measuring an individual's capacity for logical reasoning, problem-solving, and understanding abstract

concepts. It is largely associated with academic performance and the ability to process complex information. EQ, on the other hand, centers on emotional and social competencies, evaluating one's ability to recognize, understand, and manage emotions in oneself and others. This quotient is crucial for effective interpersonal relationships, communication, and leadership. AQ, the most recently developed of the three, focuses on an individual's resilience and adaptability when confronted with challenges. It gauges how well a person can persevere through difficulties, maintain motivation in the face of setbacks, and ultimately overcome adversity. Together, these three quotients provide a more comprehensive understanding of human potential, suggesting that success in life depends on a combination of intellectual prowess, emotional intelligence, and the ability to navigate and triumph over life's inevitable obstacles.

3.3.3. Measurement

Intelligence Quotient (IQ) is typically assessed using standardized tests, with two of the most widely recognized and utilized being the Wechsler Adult Intelligence Scale (WAIS) and the Stanford-Binet Intelligence Scale. These comprehensive assessments are designed to measure various aspects of cognitive ability across different age groups. The WAIS, now in its fourth edition (WAIS-IV), is primarily used for adults and older adolescents, evaluating verbal comprehension, perceptual reasoning, working memory, and processing speed. The Stanford-Binet test, currently in its fifth edition, is applicable to a broader age range, from young children to adults, and assesses five cognitive abilities: fluid reasoning, knowledge, quantitative reasoning, visual-spatial processing, and working memory. Both tests yield an overall IQ score, which is calculated by comparing an individual's performance to that of others in their age group. These standardized measures provide a consistent and reliable method for quantifying cognitive abilities, although it's important to note that they represent just one aspect of a person's overall intelligence and potential (Wechsler 1944).

Emotional Quotient (EQ) is assessed using specialized instruments designed to measure various aspects of emotional intelligence. Two prominent tools in this field are the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT) and the Bar-On Emotional Quotient Inventory (EQ-i). The MSCEIT, developed by Peter Salovey, John Mayer, and David Caruso, is a performance-based test that evaluates an individual's ability to perceive, use, understand, and manage emotions. It presents participants with tasks that directly measure their emotional skills, such as identifying emotions in facial expressions or determining effective emotional strategies in given scenarios. On the other hand, the EQ-i, created by Reuven Bar-On, is a self-report measure that assesses emotional and social functioning through questions about an individual's self-perception, interpersonal skills, stress management, adaptability, and general mood. Both instruments provide comprehensive evaluations of emotional intelligence, offering insights into an individual's emotional competencies and areas for potential development. These assessments contribute valuable information for personal growth, career development, and understanding one's capacity for emotional awareness and management in various life situations (Mayer, Salovey, and Caruso 2017).

Paul G. Stoltz developed the Adversity Response Profile (ARP) as a specialized instrument to measure an individual's Adversity Quotient (AQ), evaluating a person's capacity to face and overcome challenges across various aspects of life. The ARP focuses on four key dimensions that Stoltz identified as crucial components of AQ: Control, Ownership, Reach, and Endurance (CORE). Through a series of scenarios and questions, the assessment provides insights into an individual's typical responses to adversity, offering a comprehensive profile of their resilience. It measures the degree to which a person perceives they can influence difficult situations (Control), takes responsibility for improving challenging circumstances (Ownership), allows adversity to affect other areas of their life (Reach), and perceives how long a difficult situation will last (Endurance). The ARP not only quantifies AQ but also serves as a valuable tool for personal development, helping individuals understand their response patterns to challenges and identify strategies to enhance their resilience. This assessment has found applications in various fields, including education, business, and personal coaching, contributing to a better understanding of how individuals cope with and overcome adversity.

3.3.4. Contribution to success

Intelligence Quotient (IQ) has been widely recognized as a strong predictor of academic achievement and success in occupations that demand high levels of cognitive function. The seminal work of Schmidt and Hunter (1998) provided substantial evidence supporting this correlation. Their meta-analysis of numerous studies demonstrated that IQ scores consistently show a robust positive relationship with both educational outcomes and job performance, particularly in roles that involve complex problem-solving, analytical thinking, and information processing. Higher IQ scores tend to correlate with better grades, higher educational attainment, and increased proficiency in intellectually demanding professions such as science, engineering, and academia. However, it's important to note that while IQ is a powerful predictor, it is not the sole determinant of success. Other factors, including motivation, persistence, and emotional intelligence, also play crucial roles in overall achievement. Nonetheless, the research by Schmidt and Hunter underscores the significant value of cognitive abilities, as measured by IQ tests, in predicting academic and professional success in cognitively demanding fields.

Daniel Goleman's research and writings, particularly his work up to 2020, have significantly contributed to our understanding of Emotional Quotient (EQ) and its crucial role in various aspects of professional and personal success. According to Goleman's findings, EQ is a key factor in effective leadership, the cultivation of strong interpersonal relationships, and success in occupations that require extensive social interaction. High EQ is associated with enhanced communication skills, better conflict resolution abilities, and increased empathy, all of which are vital in leadership roles. Leaders with well-developed emotional intelligence are often more adept at motivating teams, managing stress, and creating positive work environments. In interpersonal relationships, individuals with high EQ tend to form stronger connections, demonstrate greater understanding, and navigate social complexities more effectively. In professions that involve frequent social interactions, such as sales, customer service, or counseling, EQ is particularly valuable. Goleman's work emphasizes that while traditional cognitive abilities are important, emotional intelligence often distinguishes top performers in these fields, highlighting the complementary nature of EQ to other forms of intelligence in contributing to overall success and effectiveness in both professional and personal spheres (Goleman 2020).

Paul G. Stoltz's pioneering work in 1997 established Adversity Quotient (AQ) as a crucial factor in determining an individual's resilience, persistence, and capacity to surmount obstacles in pursuit of their objectives. According to Stoltz's research, AQ plays a pivotal role in predicting how well a person can withstand adversity and overcome challenges, both in personal and professional contexts. Individuals with high AQ tend to demonstrate greater resilience in the face of setbacks, maintaining their drive and focus even when confronted with significant difficulties. This resilience translates into enhanced persistence, allowing them to continue striving towards their goals despite encountering obstacles that might deter others. Furthermore, a high AQ is associated with improved problem-solving skills and adaptability, enabling individuals to navigate complex and changing environments more effectively. Stoltz's work suggests that AQ is not a fixed trait but can be developed and improved over time, making it a valuable area for personal growth and development. The concept of AQ has since been applied in various fields, including education, business, and personal development, highlighting its importance as a complementary measure to traditional intelligence metrics in understanding and predicting human potential and success (Stoltz 1997).

3.3.5. Developmental

Intelligence Quotient (IQ), as explored in the seminal work by (Neisser et al. 1996), is generally regarded as a relatively stable attribute throughout an individual's lifespan. This stability suggests that a person's cognitive abilities, as measured by IQ tests, tend to remain consistent over time. However, the researchers also acknowledged that IQ is not entirely immutable. Environmental factors and educational experiences can exert influence on cognitive development and, consequently, on IQ scores. Quality of education, intellectual stimulation, nutrition, and overall life experiences can contribute to variations in IQ, particularly during childhood and adolescence when the brain is most plastic. The study emphasized that while there is a hereditary component to intelligence, the interplay between genetics and environment is complex. Enriching environments and targeted educational interventions can potentially enhance cognitive abilities, albeit within certain limits. This understanding of IQ as relatively stable yet somewhat malleable has important implications for educational policies and practices, suggesting that while innate cognitive abilities play a significant role, there is also room for environmental optimization to support cognitive development.

According to (Mayer et al. 2017), Emotional Quotient (EQ) or emotional intelligence is a dynamic attribute that can be cultivated and enhanced through targeted training and life experiences. Unlike IQ, which is generally considered more stable, EQ demonstrates significant potential for growth throughout an individual's lifetime. The researchers found that emotional intelligence skills, such as self-awareness, empathy, and emotional regulation, can be improved through various interventions and practices. These may include mindfulness techniques, role-playing exercises, reflective practices, and specific EQ-focused training programs. The study emphasized that as individuals engage in social interactions, face diverse emotional situations, and consciously work on understanding and managing emotions, their EQ tends to improve. This malleability of EQ has important implications for personal development, professional training, and educational curricula. It suggests that investing in EQ development can yield substantial benefits in areas such as leadership effectiveness, interpersonal relationships, and overall well-being. The research underscores the value of incorporating EQ training in various settings, from schools to workplaces, as a means of enhancing individual and collective emotional competencies.

Venkatesh and Shivaranjani (2016) research provides compelling evidence that Adversity Quotient (AQ) is a malleable trait that can be significantly enhanced through targeted interventions and training programs. Their study demonstrates that individuals can develop and improve their capacity to face and overcome challenges through structured AQ-based approaches. These interventions typically focus on enhancing the four dimensions of AQ: Control, Ownership, Reach, and Endurance. Training programs may include activities such as cognitive reframing exercises, problem-solving scenarios, resilience-building workshops, and mindset development techniques. The researchers found that participants who underwent AQ-focused training showed marked

improvements in their ability to navigate adversity, maintain motivation in the face of setbacks, and persist in pursuing their goals. This malleability of AQ has important implications for personal development, organizational training, and educational curricula. It suggests that investing in AQ development can yield substantial benefits in various life domains, including academic performance, career advancement, and overall life satisfaction. The study underscores the value of incorporating AQ training in diverse settings, from schools to corporate environments, as a means of fostering greater resilience and adaptability in individuals facing life's inevitable challenges.

3.4. The importance of AQ in facing challenges and difficulties in life and learning

Adversity Quotient (AQ) plays a crucial role in how individuals confront and overcome challenges and difficulties, both in daily life and in educational settings. In everyday situations, AQ is instrumental in determining responses to setbacks, stress, and unexpected obstacles. Individuals with higher AQ tend to exhibit greater resilience, approaching problems with a more positive and proactive mindset. They are often better equipped to maintain emotional stability during trying times, leading to more effective problem-solving and decision-making. This resilience can translate into improved personal relationships, career advancement, and overall life satisfaction. AQ also influences how people approach new and challenging situations, fostering adaptability and perseverance.

In learning contexts, AQ becomes particularly vital. Students with higher AQ are more likely to persist in the face of academic challenges, viewing difficult subjects or concepts as opportunities for growth rather than insurmountable barriers. This persistence often leads to improved academic performance and a deeper understanding of complex material. Moreover, a strong AQ can help students manage the stress associated with exams, deadlines, and competitive academic environments, potentially reducing burnout and improving overall educational outcomes. AQ contributes significantly to the development of critical life skills such as adaptability, perseverance, and problem-solving abilities, which are valuable not only in academic settings but also in professional environments. Essentially, AQ serves as a fundamental factor in shaping how individuals approach and overcome the myriad challenges encountered in both personal and academic spheres, playing a pivotal role in determining long-term success and well-being:

1. Resilience and persistence High AQ allow individuals to remain tough and persistent in the face of difficulties. They tend to see challenges as opportunities to grow and develop, not as threats to be avoided (Stoltz 1997). Research shows that students with high AQ are more likely to persist in the face of academic difficulties and achieve better performance (Hema and Gupta 2015).
2. High AQ adaptability correlates with better adaptability in the face of change and uncertainty (Stoltz 2000). In a rapidly changing world, adaptability is becoming increasingly important for success in life and learning. Research shows that students with high AQ are better able to adapt to academic demands and the transition to college (Parvathy and Praseeda 2014).
3. Emotional resilience Individuals with high AQ tend to have better emotional resilience when dealing with stress and pressure (Stoltz 1997). They are better able to manage negative emotions and maintain a positive attitude in difficult situations. Research shows that AQ is positively correlated with emotional well-being and mental health in students (Nikam and Uplane 2013).
4. High-AQ problem-solving is associated with a more proactive and effective approach to solving problems (Stoltz 2000). Individuals with high AQ tend to look for solutions rather than fixate on problems, and they are better able to learn from failure. Research shows that students with high AQ are more skilled at solving mathematical problems (Huijuan 2009).
5. AQ self-development allows individuals to see difficulties as opportunities to learn and grow (Canivel 2010). They tend to seek challenges and take calculated risks to develop their skills and abilities. Research shows that AQ is positively correlated with personal growth and self-efficacy in college students (Matore et al. 2015).
6. Motivation and persistence High AQ is related to higher levels of motivation and persistence in pursuing goals (Venkatesh and Shivaranjani 2016). Individuals with high AQ tend to remain motivated and focused even when faced with setbacks and obstacles. Research shows that AQ is positively correlated with achievement motivation in middle school students (Cando and Villacastin 2014).

In the face of an increasingly complex and challenging world, developing AQ becomes increasingly important for individual success and well-being. By cultivating resilience, adaptability, emotional resilience, problem-solving skills, self-development, motivation, and perseverance, individuals can better face adversity and reach their full potential in life and learning. Therefore, it is important for educators, parents, and individuals to understand and develop AQ as an important complement to other forms of intelligence.

3.5. Challenges in Learning Mathematics

Learning mathematics is often considered a challenge for many students. The following is a description of some of the challenges often faced in learning mathematics:

1. Math anxiety

Math anxiety remains a significant challenge for many students. Recent research shows that math anxiety can impact students' math performance, decision making, and even career choices (Foley et al. 2017; Ramirez, Shaw, and Maloney 2018; Zhang, Zhao, and Kong 2019). Math anxiety has also been linked to decreased brain activity in regions involved in mathematical reasoning (Pizzie, Raman, and Kraemer 2020).

2. Conceptual understanding
   Recent research emphasizes the importance of conceptual understanding in mathematics learning. Deep conceptual understanding allows students to apply their knowledge flexibly and transfer learning to new contexts (Rittle-Johnson, Schneider, and Star 2015). However, developing conceptual understanding can be challenging, especially when students have to overcome misconceptions or incomplete prior knowledge (Vosniadou 2019).
3. Problem solving skills
   Problem solving remains an important competency in mathematics learning. Recent research has focused on the role of metacognition (Özcan and Eren Gümüş 2019) executive function (Morgan et al. 2019) and problem-solving disposition (Jiang et al. 2021) in mathematics problem-solving skills. In addition, instructional approaches such as problem-based learning (Hanifa, Afrilianto, and Amelia 2024) and mathematical modeling (Stillman and Brown 2019) are used to improve students' problem-solving skills.
4. Negative beliefs and attitudes
   Recent research has explored the impact of beliefs and attitudes towards mathematics on student learning. Beliefs about the nature of mathematics, mathematical aptitude, and the role of effort can influence students' motivation and engagement in mathematics (Sediarin, Parangat, and Ablian 2023). Additionally, students' mathematics identity, or the extent to which they see themselves as mathematics learners, can shape their approach to the subject (Graven and Heyd-Metzuyanim 2019).
5. Individual differences
   Researchers continue to study how individual differences influence mathematics learning. Differences in cognitive skills, such as working memory (Peng et al. 2019) and fluid intelligence (Primi et al. 2012) have been linked to mathematics achievement. Additionally, factors such as socioeconomic status, language, and culture can influence students' access to quality mathematics learning.
6. Application in real-world contexts
   Connecting mathematics with real-world contexts is still a challenge in mathematics education. Recent research has emphasized the importance of authentic tasks, mathematical modeling (Cai et al. 2017), and interdisciplinary approaches (English and King 2019) to help students see the relevance of mathematics in their lives. Additionally, technological advances, such as game-based learning (Dan et al. 2024) and visualization tools (Tiwari et al. 2021), offer new opportunities to connect mathematics with real-world applications.

In today's increasingly complex and challenging world, the development of Adversity Quotient (AQ) has become paramount for individual success and well-being. AQ equips individuals with the essential skills needed to navigate life's inevitable obstacles and setbacks. By fostering resilience, adaptability, and emotional fortitude, AQ enables people to bounce back from adversity more effectively. It enhances problem-solving skills, allowing individuals to approach challenges with creativity and perseverance. Moreover, AQ cultivates a growth mindset, encouraging continuous self-development and learning from experiences. This quotient also bolsters motivation and persistence, crucial factors in achieving long-term goals and realizing one's full potential in both personal and professional spheres.

Recognizing the significance of AQ, it is imperative for educators, parents, and individuals to prioritize its understanding and development. AQ should be viewed as a vital complement to other forms of intelligence, such as IQ and EQ. By integrating AQ development into educational curricula, parenting strategies, and personal growth plans, we can better prepare individuals to thrive in an ever-changing world. This holistic approach to intelligence and capability can lead to more resilient, adaptable, and successful individuals who are better equipped to face life's challenges and contribute positively to society. As such, fostering AQ is not just beneficial for personal growth but also for creating a more resilient and capable workforce and community.

3.6. The Role of AQ in Overcoming Mathematics Learning Challenges

The Adversity Quotient (AQ) plays a crucial role in helping students overcome the challenges inherent in learning mathematics. This concept is particularly relevant in mathematics education due to the subject's reputation for complexity and abstraction, which often leads to anxiety and frustration among learners. AQ's influence on mathematics learning is multifaceted and significantly impacts a student's ability to persevere through difficulties and achieve success in this field.

In the context of mathematics learning, a high AQ enables students to approach challenging problems with resilience and determination. When faced with complex mathematical concepts or difficult problem-solving tasks, students with higher AQ are more likely to persist, viewing these challenges as opportunities for growth rather than insurmountable obstacles. This resilience is crucial in mathematics, where understanding often comes through

repeated attempts and learning from mistakes. Students with higher AQ tend to maintain their motivation and effort even when confronted with initial failures or setbacks, a quality that is essential for mastering mathematical skills that often require practice and perseverance. The adversity quotient (AQ) plays an important role in overcoming the challenges of learning mathematics. The following is a description of AQ's role in overcoming mathematics learning challenges:

1. Resilience in facing challenges: High AQ allows students to remain tough and persistent when facing difficulties in learning mathematics. Research shows that students with high AQ are more likely to persist in facing mathematical challenges and achieve better results (Hidayat 2017). This resilience helps students overcome temporary frustrations and failures in the mathematics learning process.
2. Adaptability to change: High AQ enables students to adapt to changing mathematical learning situations. Research shows that students with high AQ are better able to adapt to new challenges, such as the transition to a higher level of education or changes in the mathematics curriculum (Hastuti, Sari S, and Riyadi 2018). This adaptability helps students overcome stress and maintain their motivation to learn mathematics.
3. Developing problem-solving skills: AQ plays a role in developing mathematical problem-solving skills. Research shows that students with high AQ are more likely to use effective problem-solving strategies, such as problem decomposition and logical reasoning. They are also more persistent in facing challenging problems and learning from their mistakes.
4. Managing math anxiety: AQ can help students manage math anxiety, which is a significant challenge in learning mathematics. Research shows that students with high AQ are better able to control their emotional responses to math stress and maintain their self-confidence. This ability to manage anxiety allows students to focus on math assignments and perform better.
5. Promoting a growth mindset: AQ is closely related to a growth mindset, namely the belief that a person's abilities can develop through effort and perseverance. Research shows that students with high AQ tend to have a growth mindset in mathematics, which encourages them to seek challenges and learn from mistakes. This growth mindset helps students overcome negative beliefs about their math abilities and maintain their motivation to learn.
6. Encourage involvement and persistence: AQ can encourage student involvement and persistence in learning mathematics. Research shows that students with high AQ are more actively involved in mathematics activities and show greater effort to understand difficult concepts (Sulastry, Harapan, and Rahman 2023). This engagement and persistence help students overcome challenges and achieve a deeper understanding of mathematics.

Adversity Quotient (AQ) indeed plays a pivotal role in surmounting the diverse challenges encountered in mathematics education. Students with high AQ demonstrate enhanced resilience and adaptability, enabling them to navigate the complexities of mathematical concepts with greater ease. Their well-developed problem-solving skills allow them to approach intricate mathematical issues from multiple angles, persisting even when initial attempts fail. Moreover, high-AQ students typically manage mathematics-related anxiety more effectively, maintaining composure in the face of challenging problems or examinations.

The cultivation of a growth mindset, closely associated with high AQ, is particularly beneficial in mathematics learning. This perspective allows students to view mistakes as learning opportunities rather than indicators of innate inability, fostering a more positive and productive approach to the subject. High AQ also correlates with increased engagement and persistence in mathematical studies, qualities crucial for long-term success in the field. However, while the importance of AQ in mathematics education is evident, there remains a need for further research to identify and develop effective interventions and strategies for enhancing students' AQ specifically within the mathematics learning context. This calls for collaborative efforts between educators and researchers to create learning environments that not only teach mathematical concepts but also actively support the development of AQ. By focusing on building these crucial skills alongside mathematical knowledge, we can better equip students to overcome the inherent challenges of the subject and achieve greater success in their mathematical endeavors.

3.7. Strategies for Increasing AQ in Mathematics Learning

Increasing students' adversity quotient (AQ) in learning mathematics is an important step to help them overcome various challenges and achieve success. Creating a supportive learning environment is one of the main strategies for increasing students' AQ in mathematics learning. Teachers can design learning activities that encourage students to face challenges with confidence and perseverance. For example, teachers can assign math assignments that are challenging but achievable, as well as provide constructive feedback that emphasizes effort and improvement. A positive learning environment also involves supportive relationships between teachers and students, as well as between fellow students, which foster a sense of security and support in facing difficulties (Yazon and Manaig 2020).

Another strategy to improve AQ is to teach and model effective problem-solving skills. Teachers can guide students through the process of solving mathematical problems, including understanding the problem, developing strategies, implementing plans, and reflecting on the results. By practicing these strategies consistently, students can develop their confidence and resilience when facing challenging math problems (Kurniawati, Raharjo, and Khumaedi 2021). In addition, encouraging students to learn from mistakes and see failure as an opportunity for growth can help them develop a growth mindset, which is closely related to AQ (Parvathy and Praseeda 2014).

Integrating social-emotional learning (SEL) into math instruction can also help improve students' AQ. SEL skills, such as self-awareness, self-management, social awareness, relational skills, and responsible decision-making, can help students effectively manage their stress and emotions in the face of math challenges. Teachers can teach emotional regulation strategies, relaxation techniques, and positive self-talk that students can use when they experience difficulties in learning mathematics (Parvathy and Praseeda 2014).

Involving students in reflection and self-assessment is a powerful strategy for increasing their Adversity Quotient (AQ) in mathematics learning. By encouraging students to reflect on their strengths, weaknesses, and progress, educators can help develop self-awareness and foster a sense of ownership over their learning journey. This process of self-evaluation enables students to identify areas of improvement and recognize their growth, leading to increased confidence and motivation. Moreover, when students actively engage in assessing their own mathematical understanding, they develop metacognitive skills that are crucial for tackling complex problems and persisting through challenges.

Teachers can further enhance this process by guiding students in setting specific, measurable, and challenging yet achievable mathematics goals. This goal-setting practice, combined with regular progress monitoring, helps students stay focused and motivated when facing mathematical difficulties. By breaking down larger objectives into manageable steps, students can experience frequent success, reinforcing their belief in their ability to overcome obstacles. The ongoing reflection on progress towards these goals not only maintains student engagement but also cultivates a growth mindset – a key component of high AQ. This approach to mathematics education not only improves students' resilience and problem-solving skills but also equips them with valuable self-regulation and critical thinking abilities that extend beyond the mathematics classroom.

Finally, building a strong partnership between schools and families can support the development of students' AQ in mathematics learning. Involving parents and caregivers as partners in their children's mathematics education can expand the support and guidance available to students. Teachers can provide parents with resources and strategies to help their children overcome math challenges at home, as well as communicate regularly about student progress and needs. This strong partnership creates a complementary network of support to cultivate students' AQ in mathematics learning.

3.8. Implications and Recommendations Regarding AQ

Implications and recommendations regarding the adversity quotient (AQ) in mathematics learning have significant potential to improve educational outcomes and student welfare. One of the main implications of AQ research is the need to integrate AQ development into mathematics curriculum and instruction. Given AQ's important role in overcoming challenges and promoting student resilience, educators must explicitly teach and model AQ-related skills in the context of mathematics learning. This can involve teaching problem-solving strategies, stress management techniques, and positive thinking skills that students can apply when facing math difficulties. By integrating AQ development into daily learning, teachers can help students develop the tools they need to succeed in mathematics and life.

Another important implication is the need for assessing and monitoring students' AQ in mathematics learning. Teachers and schools should consider using AQ assessment instruments, such as the Adversity Response Profile (ARP), to gain a better understanding of their students' AQ levels. This data can inform tailored instruction, targeted interventions, and support services to help students develop their AQ. Monitoring a student's AQ over time can also provide valuable insight into the effectiveness of AQ improvement efforts and allow for adjustments as necessary.

Another important recommendation is to provide professional development for teachers on how to integrate AQ into mathematics instruction. Teachers play a critical role in shaping students' mathematics learning experiences, and they must be equipped with the knowledge and skills to support AQ development. Professional development programs should cover topics such as creating AQ-supportive learning environments, teaching AQ-improving strategies, and overcoming math anxiety (Parvathy and Praseeda 2014). By investing in teacher capacity development, schools can expand the impact and sustainability of efforts to improve AQ.

In addition, further research on AQ in mathematics learning is highly recommended. Although recent research has provided important insights, there is still much to learn about the factors that contribute to the development of AQ, the most effective interventions for increasing AQ, and the long-term outcomes of high AQ. Future research should investigate the role of contextual factors, such as family background, school climate, and

cultural factors, in shaping students' AQ. Longitudinal studies that follow students over time can also provide a deeper understanding of the developmental trajectory of AQ and its implications for math and life success.

Finally, establishing collaborative partnerships between schools, families, and communities can strengthen efforts to develop students' AQ in mathematics learning. Schools must engage parents and caregivers as partners in supporting students' math resilience and success. This may entail providing parents with resources and training on how to support math learning and AQ development at home. Additionally, building relationships with community organizations, businesses, and industry can open up opportunities for students to apply their math and AQ skills in real-world contexts.

By following through on these implications and recommendations, educators, researchers, and stakeholders can take important steps to integrate AQ into mathematics education in a holistic and systematic manner. Through collaborative and sustained efforts, we can empower students to overcome challenges, develop resilience, and reach their full potential in mathematics and life. By investing in AQ development, we can prepare students to succeed in school and in their careers, go above and beyond, and contribute to a more resilient and adaptive society.

4. CONCLUSION

Adversity Quotient (AQ) is a key factor in increasing students' academic resilience in mathematics learning. Students with high AQ are better able to overcome difficulties, remain persistent in facing challenges, and develop more effective problem-solving strategies. This AQ development fosters better emotion management, better problem-solving skills, and increased resilience, all of which are essential for success in math. Students with higher AQs are in a better position to maintain motivation and effort when faced with complex mathematical concepts or challenging problems, viewing these obstacles as opportunities for growth rather than insurmountable obstacles.

Therefore, the implementation of AQ improvement strategies in mathematics learning is a very important step for educators. To maximize the impact of AQ in education, educators are advised to adopt learning methods that encourage resilience and a growth mindset. In addition, further research is needed to evaluate the effectiveness of various approaches in improving students' AQ, as well as how environmental factors and social support can strengthen their academic resilience. By understanding the role of AQ and integrating it in mathematics education, it is hoped that students can be more confident in facing academic challenges, increase learning motivation, and achieve better academic results in the long run.

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