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Adversity Quotient Influences Self-Regulated Learning Strategies via Achievement Motivation Among Chinese University Students

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Abstract

Aims: This study explored university students' adversity quotient and its relationship with students' achievement motivation and self-regulated learning strategies in the Chinese context. Methods: A total of 319 Chinese university students responded to a questionnaire that measures the adversity quotient (control, ownership, reach, endurance, and transcendence), achievement motivation (motive to success and motive to avoid failure), and self-regulated learning strategies (general strategies for learning and clarification strategies for learning). Confirmatory factor analysis and structural equation modeling were employed to analyze the data. Results: The results indicated that (1) control and ownership directly and positively correlated with self-regulated learning strategies; (2) control and endurance positively correlated with self-regulated learning strategies mediated by their motive to achieve success; (3) reach negatively correlated with students learning strategies through the motive to achieve success; and (4) control, ownership, and endurance negatively correlated with the motive to avoid failure while reach was positively correlated with it. Conclusions: This study shows that developing university students' adversity quotient is essential. It implies that achievement motivation can be one possible mechanism underlying relationships between the adversity quotient and self-regulated learning strategies.

Keywords: university students; adversity quotient; achievement motivation; self-regulated learning strategies

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1. Introduction

To achieve learning goals, it is necessary for students to overcome unavoidable difficulties or challenges in the learning process (Sahin, 2019; Sriyanti et al., 2025). The adversity quotient (AQ) plays a promising role in determining the ability to survive problems and hardships. Stoltz (1997) defined the AQ as being one's capability to deal with adversities in their life, which includes four dimensions, named as control, ownership, reach, and endurance. The AQ is a crucial predictor of various outcomes such as learning, creativity, performance, and motivation (Dorji & Singh, 2019; Phoolka, 2012; Sriyanti et al., 2025; Stoltz, 2010). For example, high-AQ students regard difficulties as an opportunity

for self-development and might handle adversity events positively (Dorji & Singh, 2019; Hulaikah et al., 2020).

Learning strategies are a crucial element for success in students' learning process, such as promoting academic achievement (Ergen & Kanadli, 2017), becoming a lifelong learner (Weinstein et al., 2011), and taking more responsibility for learning (Carpenter & Pease, 2013). In particular, self-regulated learning strategies (SRLSs) are important for college students to perform well in learning and, more importantly, these strategies are controllable and teachable (Pintrich, 1995; Zimmerman, 2002). Previous studies have demonstrated that the AQ positively impacts academic performance (Bakare, 2015), motivation (Lin & Chen, 2011), cognitive development (Hidayat et al., 2019), and learning strategies (Istiqomah et al., 2025; Yustiana et al., 2021). However, most studies merely explored those relationships from an overall perspective without considering the possibly distinct effects of different AQ dimensions. According to the self-regulated learning process, a sense of control or responsibility for learning might help students become self-regulated learners (Zimmerman, 2002), which was examined by previous studies. For example, students had a high level of SRLSs when they perceived high classroom control (Eshel & Kohavi, 2010) or were more responsible for their own learning (Demiroren et al., 2016). Therefore, two dimensions of the AQ (i.e., control and ownership) might closely correlate with SRLSs. However, the relationships between SRLSs and other dimensions of the AQ (i.e., reach, endurance, and transcendence) are understudied.

Similarly, the AQ has a strong theoretical relationship with achievement motivation (AM) (McClelland & Mac Clelland, 1961), which has been supported by empirical studies (Lin & Chen, 2011; Tian et al., 2011). In addition, some studies also reported the significant relationship between AM and SRLSs (Han & Lu, 2017; Sen & Yurdagül, 2014). According to the onion model, students' essential personality traits in the innermost layer could affect their preferred learning techniques/environment in the outermost layer via the second layer, i.e., the information processing dimension (Basheer et al., 2016; Curry, 1983). Therefore, students' AQ might affect learning strategies via their motivation.

The current study aimed to understand the relationships among each dimension of the AQ, AM, and SRLSs. This would provide a nuanced understanding of the role of the AQ in students' learning process and, therefore, provide insights for enhancing students' academic achievement.

2. Literature Review

2.1. Personality Traits and Behavior

Previous studies provide solid foundations for bridging personal traits or intelligence to observable behaviors (Curry, 1983; Jiang et al., 2021). The AQ is a typical intelligence (Effendi et al., 2016; Yodsakun & Kuha, 2008), which might influence behaviors, such as learning strategies (Amir Mz et al., 2021). The onion model can help one understand how all of these work (Basheer et al., 2016; Curry, 1983; Weisskirch, 2016; Zajacova, 2013). The onion model depicts three interactive layers: the personality dimension (the inner layer), the information processing dimension (the middle layer), and the environmental elements or learning techniques (the outer layer). Past studies demonstrate that students' personalities are the fundamental factors determining their learning behavior, while information processing provides a pathway for personality to interact with learning behaviors (Basheer et al., 2016; Curry, 1983). Moreover, Social Cognitive Theory (Bandura, 2001) may also explain this relationship. This study posits that the AQ, reflecting resilience and self-efficacy in the personality dimension, enhances achievement motivation in the information processing dimension. AM, in turn, drives the use of SRLSs in the outer layer. For example, Jiang et al. (2021) found that students' cognitive learning strategies (i.e., elaboration, rehearsal, and

organization) were influenced by grit through academic self-efficacy. Thus, consistent with both the onion model and Social Cognitive Theory, we hypothesized that students' AQ influences their self-regulated learning strategies through the mediating role of achievement motivation. In other words, students' AQ (the personality dimension in the inner layer) influences their SRLSs (learning techniques in the outer layer) through the mediation of AM (the information processing dimension in the middle layer) (see Figure 1).

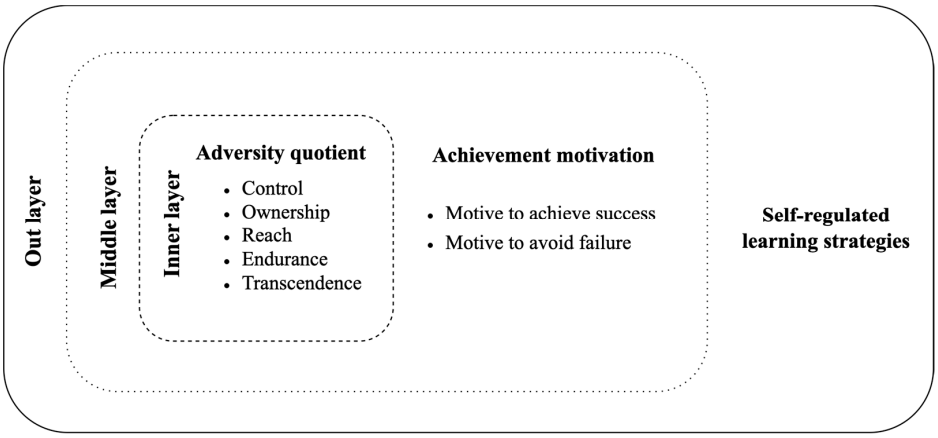

Figure 1. The hypothesized model (designed by XW and ZY).

2.2. The Adversity Quotient and Self-Regulated Learning Strategies

Stoltz (1997) first proposed the AQ framework, which is widely used in the education field (Ratna et al., 2020). The AQ concept draws insights from several human and social sciences branches, including cognitive psychology, psychoneuroimmunology, and neurophysiology (Stoltz, 1997, 2010). In Stoltz's (1997) framework, there are five major sub-constructs, named CO2RE, representing control, origin, ownership, reach, and endurance. *Control* refers to the sense of control over adversity situations and individual responses regarding an individual's internal control. *Origin* refers to the source of the problem. *Ownership* concerns taking responsibility in adversity situations. *Reach* refers to how far adversity influences one's life. *Endurance* refers to how long the hardship and its causes might endure. Based on Stoltz's framework and grounded Chinese cultural contexts, X. Wang et al. (2022) added a new dimension, *transcendence*, which is a sense of positive acceptance of adversity situations. In other words, it refers to affinity towards, rather than alienation from, adversity situations, advocating for individuals to actively take advantage of adversity instead of running away.

The AQ can influence one's learning strategies because students with high AQs regard problems as learning opportunities and attempt diverse strategies to solve them instead of giving up (Fitri, 2017). According to Weinstein et al. (2011), learning strategies refer to how students cope with learning materials and assignments, including various techniques to understand and store academic material. Some studies explored the relationship between the AQ and learning strategies from a quantitative perspective. For example, Hidayat and Prabawanto (2018) found that high-AQ students performed better than low-AQ students when solving problems. They took diverse learning strategies, such as setting the correct steps for the solution and checking the answers, to solve problems. In addition, high-AQ students showed more fluency and flexibility in creative skills when solving problems in mathematics (Nahrowi et al., 2020). Purnamasari et al. (2019) also used more reflective thinking strategies in mathematical problem solving. However, the literature shows that previous studies mainly applied a qualitative approach to test the relationship between the AQ and SRLSs. It is essential to provide quantitative evidence because the main disadvantage of qualitative methods is that their findings cannot be extended to broader

populations (Ochieng, 2009). In addition, the learning strategies investigated in previous studies focused on problem solving in a mathematical context (Suryaningrum et al., 2020). Such a specificity offers an in-depth understanding of the impact of the AQ in a particular subject, but, at the same time, it limits the scope of the implications of the findings because challenges faced by students may vary across subjects. It is crucial to examine the relationship between the AQ and general learning strategies (i.e., SRLSs). Furthermore, no studies examined how the different dimensions of the AQ (control, ownership, reach, endurance, and transcendence) relate to SRLSs among university students. This line of research will provide a nuanced understanding of the specific influence of each dimension of the AQ on SRLSs, which can inform the development of targeted and efficient intervention programs (Schoeps et al., 2021).

2.3. Achievement Motivation as a Mediator

The relationship between the AQ and learning strategies may be mediated by AM, as specified in the onion model (Basheer et al., 2016). AM is the need for achievement or the tendency to overcome obstacles, exercise power, and strive to do something difficult as quickly as possible (McClelland & Mac Clelland, 1961). It can be a simulation to arouse and maintain people's behavior. Past studies argued that motivation was a mediator between personal traits and learning behaviors (Kil et al., 2021; Sen & Yurdagül, 2014). Sen and Yurdagül (2014) found that student motivation partially mediated the path that epistemological belief (i.e., learning depends on effort) positively affected learning strategies. Students who value effort are good at self-motivation during learning and are prone to construct new knowledge with various learning strategies. Kil et al. (2021) reported that one aspect of mindfulness (i.e., acting with awareness) could manifest prosocial behavior with internalized prosocial motivation as a mediator.

In terms of learning, students with higher AM are inclined to promote their academic achievement via various learning strategies (Bakhtiarvand et al., 2011). In addition, Stoltz (1997) argued that people with higher AQ had a strong motivation to pursue success. Several studies found that the AQ positively correlated with AM. Tian et al. (2011) reported that the AQ positively predicted the motive to achieve success ($\beta = 0.12$, $p < 0.001$) and negatively predicted the motive to avoid failure ($\beta = -0.30$, $p < 0.001$). Cornista and Macasaet (2013) found that the control ($r = 0.26$, $p < 0.05$) and ownership ($r = 0.28$, $p < 0.01$) dimensions of the AQ had a positive relationship with motivation for achievement. Safi'i et al. (2021) also identified the AQ as a significant predictor for students' AM ($\beta = 0.42$, $p < 0.001$). In addition, a case study on high school students illustrated that students with high AQs had high AM and could handle mathematics learning in different materials and with various learning strategies (Hastuti et al., 2018).

Regarding the relationship between AM and the utilization of learning strategies, the motive to achieve success (Ms) had a positive and significant correlation with four learning strategies, i.e., cognitive, metacognitive, affective, and social. However, no significant relationship was found between the motive to avoid failure (Mf) and learning strategies (Han & Lu, 2017). Hong et al. (2020) reported that students with high AM would use various strategies to plan studying, self-assess mastery, and monitor achievement. Bakhtiarvand et al. (2011) found that students with high AM were more likely to apply efficacious learning strategies such as a deep approach. Therefore, we assumed that AM was a potential mediator between the students' AQs and their SRLSs.

3. Research Questions

Although past studies have examined the relationships between the AQ, AM, and SRLSs separately, a natural question to ask is how these three interplay. In particular, the

potential mediating role of AM in the relationship between the AQ and SRLSs has not been examined. Moreover, past studies regarded the AQ as an overall construct when examining its relationship with other variables without providing a nuanced picture of how each dimension of the AQ relates to SRLSs. This study aimed to address this research gap, and the two specific research questions were as follows:

(1) What are the relationships between SRLSs and the five dimensions of the AQ, including control, ownership, reach, endurance, and transcendence?
(2) Is the relationship between the AQ and SRLSs mediated by AM?

4. Method

4.1. Participants and Procedure

The study was approved by the Human Research Ethics Committee of the first author's affiliated university (Ref. 2022-2023-0197). As a criterion for sample inclusion, participants needed to be university students who had attended at least one semester of their course. Participants were recruited from a university in Anhui Province, located in Eastern China. Participation was voluntary, and we used convenience sampling. Data were collected anonymously through a 15 min online survey. Informed consent was obtained, and participants were informed that they had the right to withdraw from the study at any time without any negative consequences. The survey was sent to 344 students, and 319 valid responses (92.7%) were collected, with a mean age of 20.51 years (range = 16–24; SD = 1.56), and more than half of the students were female (N = 202, 63.3%).

4.2. Instruments

Students' AQ was measured by the Adversity Profile Response for Chinese University (APR-CUS) developed by X. Wang et al. (2022) based on Stoltz's (1997) adversity response profile. The instrument has twenty-four items assessing five dimensions of the AQ (the internal consistency index Cronbach alphas obtained in X. Wang et al.'s (2022) study are included in parentheses below): (1) control (5 items; α = 0.73; sample item "To what extent can you influence when you suffer an academic setback."); (2) ownership (5 items; α = 0.74; sample item "To what extent do you feel responsible for improving the situation when you are overlooked for the opportunity of being given an excellent person award."); (3) reach (5 items; α = 0.80; sample item "how far this situation would affect your life if you are criticized for a subject assignment."); (4) endurance (5 items; α = 0.79; sample item "how long this situation would influence your life if you accidentally delete an important message."); and (5) transcendence (5 items; α = 0.72; sample item "Even though you put in lots of effort, you still failed the exam. You believe this is a necessary step for success.") All items adopted a 5-point Likert scale with a higher score indicating a higher level of the AQ.

A short form of the Achievement Motive Scale (Tang & Lu, 2013) was applied to assess students' AM. This scale has two subscales: (1) Ms: the motive to achieve success (6 items; α = 0.81; sample item "I am attracted by task, in which test my ability."); (2) Mf: the motive to avoid failure (6 items; α = 0.85; sample item "I feel uneasy to do something if I am not sure of succeeding.")

SRLSs were measured by the revised motivated strategies for the learning questionnaire (Dunn et al., 2011). This scale has two subscales: (1) general strategies for learning (GSLs; 5 items; α = 0.74; sample item "I work hard to do well in this class even if I don't like what we are doing."); and (2) clarification strategies for learning (CSLs; 3 items; α = 0.70; sample item "If I get confused taking notes in class, I make sure I sort it out afterward.").

4.3. Data Analysis

According to the theory of Kline (1998), at least 20 samples are considered per parameter in the model, since there are 9 components and parameters in the model. Hence, the minimum sample size is 180. We first removed the cases (n = 25; 7.3%) with uniform responses to all questions (Sarstedt & Mooi, 2014). Next, structural equation modeling (SEM) with Mplus 8.0 was applied to test our hypothesized model (Jöreskog & Sörbom, 1993). A two-step approach was used in this study (Anderson & Gerbing, 1988; Thomas-Francois et al., 2023; Zhang et al., 2025): (1) the measurement properties of each scale were examined via confirmatory factor analyses, and (2) SEM was used to examine structural relations among constructs (see Figure 2). Multiple fit indices were used to examine model fit, including the chi-square by degrees-of-freedom value (smaller than 3), the Tucker–Lewis index (TLI, larger than 0.09), the comparative fit index (CFI, larger than 0.09), the standardized root-mean-square residual (SRMR, smaller than 0.08), and the root-mean-square error of approximation (RMSEA, smaller than 0.08) (Hu & Bentler, 1999; McDonald & Ho, 2002; J. Wang & Wang, 2019). In addition, composite reliability (CR) and average variance extracted (AVE) were applied to assess the convergent power (Fornell & Larcker, 1981). The cutoff values for CR and AVE were 0.60 and 0.36, respectively (Fornell & Larcker, 1981). The discriminant validity was identified by comparing the square root of AVE and correlations between dimensions.

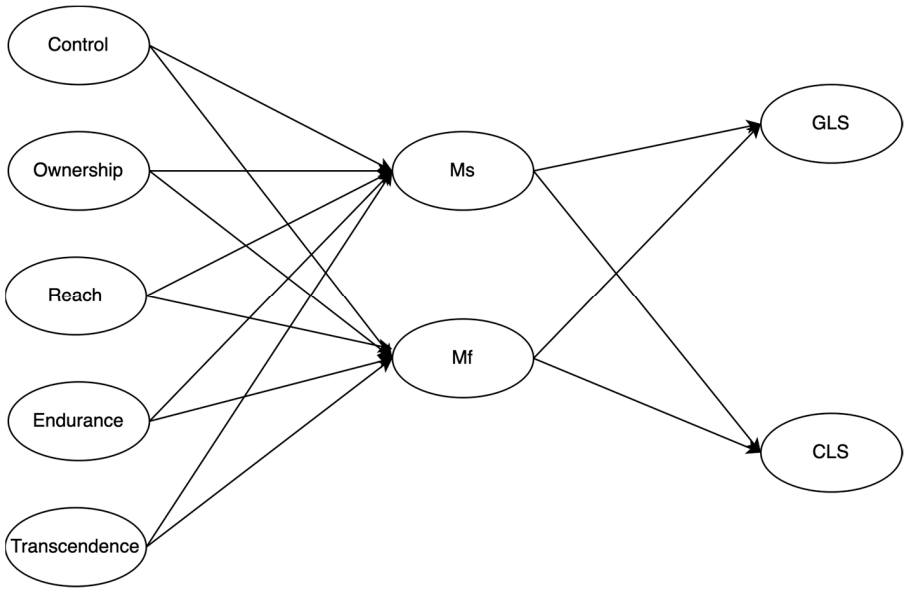

Figure 2. The hypothesized SEM model. Ms: the motive to success; Mf: the motive to avoid failure; GLSs: general strategies for learning; CLSs: clarification strategies for learning.

5. Results

5.1. Measurement Model

5.1.1. Adversity Quotient

The *adversity response profile for Chinese university students* (APR-CUS) includes five intercorrelated factors (i.e., control, ownership, reach, endurance, and transcendence). The results of the CFA for the ARP-CUS scale showed good fit indices (χ^2 = 356.716; df = 239; χ^2/df = 1.493; RMSEA = 0.039; CFI = 0.941; TLI = 0.932; SRMR = 0.056). Factor loading for the items of the ARP-CUS ranged from 0.335 to 0.829 (see Appendix A). As displayed in Table 1, Cronbach's α coefficients for the five factors ranged from 0.700 to 0.817. The composite reliability (CR) ranged from 0.786 to 0.901, greater than the cutoff value of 0.600 (Fornell & Larcker, 1981), indicating acceptable construct reliabilities. In addition, the value

of average variance extracted (AVE) exceeded the 0.36 threshold (Fornell & Larcker, 1981), indicating that the convergent validity was acceptable. The square root of the AVE was higher than its corresponding correlation coefficients, showing good discriminant validity.

Table 1. Reliabilities for the main variables in the study.

	Cronbach's α	CR	AVE
Adversity quotient			
Control	0.718	0.743	0.374
Ownership	0.803	0.787	0.435
Reach	0.817	0.807	0.461
Endurance	0.790	0.792	0.436
Transcendence	0.700	0.733	0.425
Achievement motivation			
Ms	0.854	0.854	0.496
Mf	0.830	0.832	0.463
Self-regulated learning strategy			
SRLS	0.910	0.908	0.555

Note: n = 319; CR = composite reliability; AVE = average variance extracted; Ms = motive to achieve success; Mf = motive to avoid failure; SRLS = self-regulated learning strategy.

5.1.2. Achievement Motive

The results for the AM scale showed a satisfactory model fit (χ^2 = 125.853; df = 53; χ^2/df = 2.375; RMSEA = 0.066; CFI = 0.936; TLI = 0.920; SRMR = 0.055). The factor loadings of the items were all higher than 0.400 (0.473–0.812) (see Appendix A). Cronbach's α coefficients were higher than 0.700, and the values of CR were higher than the threshold (0.832–0.854). Furthermore, the values of AVE (0.463–0.496) and their square root showed that the convergent validity and the discriminant validity were acceptable.

5.1.3. Self-Regulated Learning Strategy

The self-regulated learning strategy (SRLS) tool with 8 items consists of two factors (i.e., GLS and CLS). The 2-factor model demonstrated a sufficient fit (χ^2 = 36.765; df = 19; χ^2/df = 1.935; RMSEA = 0.056; CFI = 0.968; TLI = 0.952; SRMR = 0.049). However, the discriminant validity appeared poor (i.e., $r_{GLS\ \&\ CLS}$ = 0.790 was larger than the square root of the AVE values for GLS, 0.731). According to Falkner et al. (2014), we combined the GLS with the CLS into a one-factor SRLS and repeated the analyses. The one-factor model fit the data well (χ^2 = 52.843; df = 18; RMSEA = 0.078; CFI = 0.957; TLI = 0.933; SRMR = 0.043), and the factor loading for the items of SRLSs ranged from 0.561 to 0.857 (see Appendix A). Furthermore, Cronbach's α coefficient (0.910) and AVE (0.555) indicated acceptable reliability and convergent validity, respectively.

5.2. Descriptive Statistics and Correlations

Table 2 shows correlations between all the variables. All AQ factors were positively related to the Ms (0.216–0.409) and SRLS (0.393–0.449). In contrast, all AQ factors were negatively related to the Mf (−0.107–−0.297).

Table 2. Descriptive statistics and correlations for the main variables in the study.

	M	SD	1	2	3	4	5	6	7	8
1. Control	3.720	0.661	**0.612**							
2. Ownership	3.740	0.679	0.533 **	**0.660**						
3. Reach	3.555	0.792	0.520 **	0.283 **	**0.679**					
4. Endurance	3.433	0.777	0.509 **	0.224 **	0.561 **	**0.660**				
5. Transcendence	3.522	0.676	0.413 **	0.372 **	0.374 **	0.401 **	**0.652**			
6. Ms	2.575	0.540	0.409 **	0.291 **	0.216 **	0.351 **	0.330 **	**0.704**		
7. Mf	2.695	0.506	−0.215 **	−0.127 *	−0.107	−0.245 **	−0.060	−0.297 **	**0.680**	
8. SRLS	4.485	0.709	0.471 **	0.449 **	0.393 **	0.395 **	0.401 **	0.424 **	−0.130 *	**0.745**

Note: M = mean; SD = standard deviation; diagonal elements in bold are the square root of the AVE values; * >0.05; ** >0.01; Ms = motive to achieve success; Mf = motive to avoid failure; SRLS = self-regulated learning strategy.

5.3. The Structural Model: Adversity Quotient, Achievement Motivation, and Self-Regulated Learning Strategies

After examining the measurement models, we ran a structural equation model (see Figure 2) to test our hypotheses. The results demonstrated sufficient model-data fit: χ^2 = 1243.727; df = 867; χ^2/df = 1.435; RMSEA = 0.037; CFI = 0.926; TLI = 0.919; and SRMR = 0.056 (Figure 3). Generally, the AQ (control, ownership, reach, endurance, and transcendence) had a positive correlation with Ms and a negative correlation with Mf. By contrast, reach was negatively related to Ms and positively related to Mf in this study. Control, ownership, and Ms had a positive association with SRLSs. Transcendence had no significant correlation with AM or SRLSs. Standardized regression weights showed that control (β = 0.529, $p < 0.001$) and endurance (β = 0.238, $p < 0.01$) had a positive correlation with Ms, while reach (β = −0.360, $p < 0.01$) was negatively related to Ms. Approximately 35% of the variance of Ms was explained by these three AQ variables. In terms of Mf, three dimensions of the AQ had a negative association with it: control (β = −0.300, $p < 0.01$), ownership (β = −0.167, $p < 0.05$), and endurance (β = −0.420, $p < 0.01$). Reach (β = 0.361, $p < 0.01$) was positively related to Mf. These four variables together accounted for about 18% of the variance in Mf. Furthermore, control (β = 0.244, $p < 0.05$), ownership (β = 0.303, $p < 0.001$), and Ms (β = 0.190, $p < 0.05$) were positively related to SRLSs, explaining 49% of the variance of SRLSs.

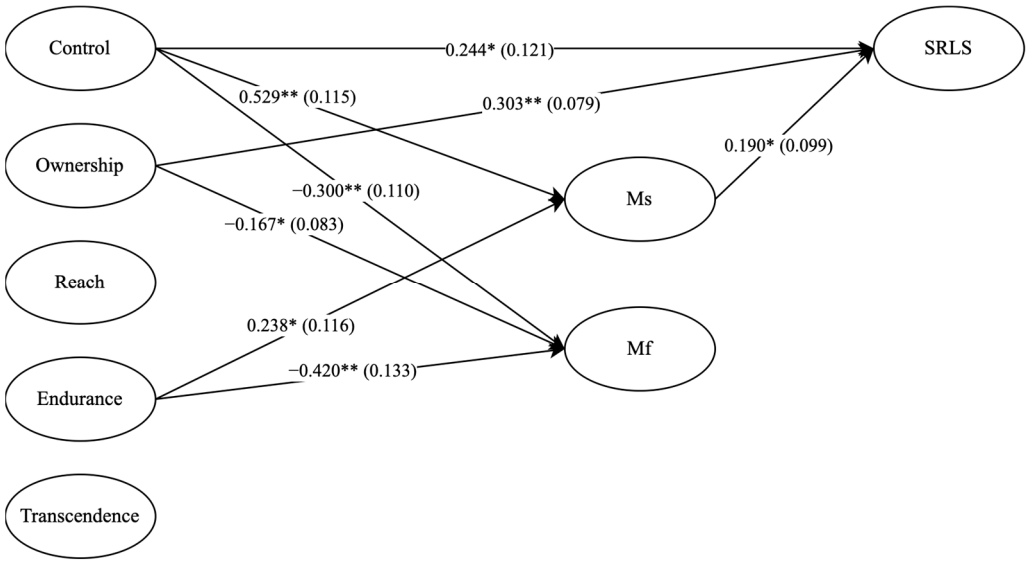

Figure 3. The structural model of adversity quotient, achievement motivation, and self-regulated learning strategies (intercorrelation and error terms were removed for simplicity). * >0.05; ** >0.01.

A direct effect in a structural model is frequently used to imply a causal relationship between two variables, while an indirect effect suggests a causal relationship between two variables via a mediating variable. In this study, there were direct effect paths from control, ownership, and Ms to SRLSs, and indirect effect paths from control, reach, and endurance to SRLSs, mediated via Ms. Table 3 displays the effect coefficients.

Table 3. Total, direct, and indirect effects on students' self-regulated learning strategies.

Variables	Direct Effect	Indirect Effect	Total Effect
Control	0.244	0.101	0.345
Ownership	0.303	-	0.303
Reach	-	−0.068	−0.068
Endurance	-	0.045	0.045
Ms	0.190	-	0.190

Note: Ms = motive to achieve success.

6. Discussion

This study examined the relationship between students' AQs, AM, and SRLSs. It tested whether or not AM mediates the relation between the AQ and SRLSs. The results demonstrated that students' SRLSs have significant correlations with two dimensions of the AQ (i.e., control and ownership) directly. And the relationship between the SRLSs of students and the partial dimension of the AQ (i.e., control, reach, and endurance) was mediated by the Ms.

In the theoretical framework of the AQ (Stoltz, 1997, 2010), control and ownership are critical factors in promoting action and change in adversity situations. If individuals are able to control or change the adverse situation, they will adaptively cope with difficulties. In addition, individuals with a high sense of ownership tend to learn from suffering instead of avoiding responsibility; they are more willing to overcome adversity and improve the situation. In line with this theoretical framework, our finding shows that the dimension of ownership and control is significantly positively correlated with SRLSs. This finding also echoes previous studies (Hulaikah et al., 2020; Yustiana et al., 2021) in that students would be more willing to use SRLS when they perceive themselves as being responsible for the adversity situations or believe they could control adversity events. For example, Hulaikah et al. (2020) reported that students with high AQs were good at utilizing learning strategies in problem solving, in particular for those students who perceived that they could control themselves to face adversity in math learning, and those who had a high sense of responsibility in facing difficulties in math learning. This study not only provided evidence for the relationship between the AQ and learning strategies but also extended learning strategies from merely focusing on problem-solving strategies in mathematics to more general SRLSs.

Our findings also confirmed the relationship between the AQ and AM identified in previous studies, both in Western (Ajiwibawani et al., 2017; Cornista & Macasaet, 2013) and Eastern backgrounds (Lin & Chen, 2011; Tian et al., 2011). In those studies, control was the most relevant construct of AM among all variables. One possible explanation might be relevant to Rotter's (1975) locus of control theory. The internal control believes success depends on themselves, while the external control believes success is caused by external forces such as power or opportunity beyond their capabilities. The control dimension of the AQ here can be interpreted as a type of internal control (Stoltz, 1997, 2010). Therefore, people who think they can control their success are more likely to take the initiative to cope with adversity and setbacks adaptively (Tian et al., 2011).

In this study, we also found a significant negative correlation between control, ownership, endurance, and the Mf, which is congruent with previous studies (Lin & Chen, 2011;

X. Wang et al., 2022). One viable explanation is that students with high AQs are more confident in overcoming difficulties or dealing with problems because they have a sense of control and responsibility for adversity and believe that the impacts of adversity are temporary. Therefore, they would not be afraid of failure. This finding might also be explained from the perspective of self-worth theory (Covington, 1984). Students' self-worth could be threatened by failed performance on academic assignments because failed performance could be related to low ability. Therefore, students who showed a low level of the AQ might avoid failure in given tasks to prevent them from exposing their low abilities.

Interestingly, the path coefficient in SEM (positive with Mf and negative with Ms) and the correlation coefficient (positive with Ms and negative with Mf) between reach and the AQ did not have the same sign. A possible reason could be that the original relationship between the two had been suppressed. As Falk and Miller (1992) suggested, this relationship was examined and caused by "real suppression," i.e., when the necessary predictor is eliminated, a specification error occurs. In this case, the correct sign is interpreted by the path coefficient. Therefore, reach had a negative correlation with Ms and a positive correlation with Mf. According to achievement motivation theory (McClelland & Mac Clelland, 1961), a possible explanation is that students tend to avoid failure when they perceive the consequence of adversity only influencing the current situation, because the cost of overcoming the difficulty might be higher than failure avoidance. However, students who hold different beliefs (i.e., they believed the influence of an adversity situation would impact every part of their life) tended to achieve success. A reason for this might be that the effort to cope with adversity is lower than avoiding failure in every aspect of life. Thus, there were two different motivations for higher AQ students and lower AQ students. Finally, there was no statistically significant association between transcendence and AM and SRLSs separately. This might mean that transcendence does not necessarily lead to adaptive outcomes (i.e., AM and SRLSs). From the perspective of Confucianism, individuals focus on how to self-enhance by suffering when they have a sense of transcendence (Jing, 2006). They are more likely to actively accept adverse events. Although the factor of transcendence helps overcome difficulties (Jing, 2006; X. Wang et al., 2022; Yan & Mok, 2012), it is hard to promote students to develop AM and SRLSs.

This study also showed that students' AQ affects their learning strategies directly and indirectly. It is evident that students' ability to deal with adversity is significantly correlated with their SRLSs and AM. Students with high AQs are more confident in coping with difficulties in life and academics; they are also successful in self-encouraging during learning; and they tend to conduct both general (e.g., "When reading for this course, I make up questions to help me focus my reading.") and clarification (e.g., "If I get confused taking notes in class, I make sure I sort it out afterward.") strategies. This finding is in line with previous studies (El-Adl & Alkharusi, 2020; Hastuti et al., 2018). For instance, El-Adl and Alkharusi (2020) found that students were more likely to use cognitive and self-related strategies when motivated to learn, had the confidence to learn, and were capable of controlling their learning. In general, the relevance of the AQ is that student response to adversity might facilitate AM, thus affecting the utilization of SRLSs. By integrating the onion model, we can view the AQ as part of the personality dimension, which interacts with the information processing dimension (AM) to affect learning techniques (SRLSs) in the outer layer. When examining the relationships among each dimension of the AQ, AM, and SRLSs, we found that reach negatively correlated with SRLSs via AM. This means that students with a high reach level may be less likely to utilize SRLSs. The findings suggest that students' AQs may not always positively correlate with their AM and SRLSs. Therefore, it may be inappropriate to simply aggregate the AQ when considering these relationships, as the dynamics are more complex and interconnected within the cognitive framework.

7. Limitations and Future Directions

There are several limitations in the current study. First, as the research design was cross-sectional, it is hard to claim causality. Future studies should consider a longitudinal design. Second, the data in this study were from a convenience sample, which may have introduced self-selection bias. Thus, more rigorous sampling methods (e.g., a stratified sampling method) could be used in future investigations. Furthermore, the data used in this study were all from self-reporting instruments that might have involved response biases. Future studies should use different sources (e.g., interviews and observations) to corroborate the statistical evidence reported in this paper.

8. Conclusions and Implications

This study aimed to examine the relationship between the AQ, AM, and SRLSs. Revisiting the literature, we found that while previous studies have examined these constructs collectively, our research highlights the impact of each dimension of the AQ on AM and SRLSs. The data collection process was essential in uncovering these relationships, leading to findings that indicate that the control and responsibility dimensions of the AQ positively correlate with students' SRLSs. Additionally, we discovered that the control, reach, and endurance dimensions of the AQ are indirectly associated with SRLSs through AM.

Emerging themes from our analysis suggest that fostering a sense of control and responsibility can significantly enhance students' ability to navigate adversity, thereby promoting effective SRLSs. These findings have important implications for both theory and practice, as they underscore the need for educational strategies that support the development of these skills in students. For future research, we recommend investigating how different educational contexts may influence the relationship between the AQ, AM, and SRLSs, as well as exploring interventions that specifically target the enhancement of control and responsibility in students. This approach could provide further insights into improving educational outcomes.

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Appendix A. ARP-CUS, AM, and LS Items and Factor Loadings

Construct	Item	Factor Loading
Control	C1. You suffer an academic setback.	0.679
	C2. People don't like your idea during a discussion.	0.530
	C3. Your personal and study obligations are out of balance.	0.738
	C4. You have a conflict with your family.	0.631
	C5. Your computer crashed for the third time, wasting your time.	0.429

Construct	Item	Factor Loading
Ownership	O1. You are overlooked for the opportunity of being given an excellent person award.	0.829
	O2. Someone you respect ignores your attempt to discuss an important issue.	0.757
	O3. One of your important friends did not show up on your birthday.	0.606
	O4. You fail to complete the work arranged by the teacher.	0.456
	O5. You fail a specific course.	0.583
Reach	R1. You are criticized for a subject assignment.	0.765
	R2. The important activity you are taking on gets cancelled.	0.771
	R3. You go through a significant number of bad patches in one day.	0.552
	R4. You miss an important appointment.	0.556
	R5. Your teacher adamantly disagrees with your idea.	0.715
Endurance	E1. You accidentally delete an important message.	0.644
	E2. You argue with someone and develop negative emotions.	0.724
	E3. You leave some messages for a friend, but without any reply.	0.724
	E4. You missed a flight or a train when you were traveling.	0.669
	E5. You lost something important to you.	0.518
Transcendence	T1. You believe that it is beneficial to tactically compromise when arguing with a friend.	0.671
	T2. Even though you put in lots of effort, you still failed the exam. You believe this is a necessary step for success.	0.746
	T3. You have no idea about how to complete work assigned by a teacher. You believe that it is not necessary to worry about it; it can be addressed eventually.	0.335
	T4. You go through lots of bad patches during a period. You believe this is a good chance to strengthen your will.	0.762
Motive to achieve success	M1. I enjoy putting effort into tasks even when I am unsure if I can accomplish them.	0.648
	M2. I like trying new and unfamiliar tasks in my studies, even if my initial attempts are not successful.	0.711
	M3. I feel excited and happy when faced with challenging tasks.	0.799
	M4. I am attracted to the challenges.	0.745
	M5. My interest is quickly sparked by challenges that I cannot master right away.	0.663
	M6. I am attracted to work that I am uncertain as to whether I would be successful.	0.646
Motive to avoid failure	M7. I am afraid of failing in uncertain situations.	0.500
	M8. I become anxious when I encounter new and unfamiliar tasks.	0.473
	M9. I feel quite anxious about tasks when I am not sure I will succeed.	0.779
	M10. I am afraid of failing in challenges where much depends on the specific opportunities.	0.777
	M11. I worry about tasks that seem very difficult.	0.812
	M12. I feel anxious about challenges that I cannot master immediately.	0.657
Learning strategy	L1. When reading for this course, I make up questions to help me focus my reding.	0.598
	L2. If course materials are difficult to understand, I change the way I read the material.	0.762
	L3. I work hard to do well in this class even if I don't like what we are doing.	0.750
	L4. I ask myself questions to make sure I understand the material I have been studying in this class.	0.694
	L5. Even when course materials are dull and uninteresting, I manage to keep working until I finish.	0.832
	L6. When I become confused about something I'm reading for this class, I go back and try to figure out it.	0.867
	L7. When studying for this course I try to determine which concepts I don't understand well.	0.816
	L8. If I get confused taking notes in class, I make sure I sort it out afterwards.	0.795

References

Ajiwibawani, M. P., Harti, & Subroto, W. T. (2017). The effect of achievement motivation, adversity quotient, and entrepreneurship experience on students entrepreneurship attitude. *International Journal of Academic Research in Business and Social Sciences*, *7*(9), 441–450. [CrossRef]

Amir Mz, Z., Risnawati, R., Nurdin, E., Azmi, M. P., & Andrian, D. (2021). The increasing of math adversity quotient in mathematics cooperative learning through metacognitive. *International Journal of Instruction*, *14*(4), 841–856. [CrossRef]

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*(3), 411–423. [CrossRef]

Bakare, B. (2015). *Students' adversity quotient and related factors as predictors of academic achievement in the west African senior school certificate examination in southwestern Nigeria* [Unpublished doctoral dissertation]. Retrieved on 9 November 2017.

Bakhtiarvand, F., Ahmadian, S., Delrooz, K., & Farahani, H. A. (2011). The moderating effect of achievement motivation on relationship of learning approaches and academic achievement. *Procedia Social and Behavioral Sciences*, *28*, 486–488. [CrossRef]

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, *52*(1), 1–26. [CrossRef] [PubMed]

Basheer, G. S., Tang, A. Y., & Ahmad, M. S. (2016). Designing teachers' observation questionnaire based on curry's onion model for students' learning styles detection. *TEM Journal*, *5*(4), 515–521. [CrossRef]

Carpenter, J. P., & Pease, J. S. (2013). Preparing students to take responsibility for learning: The role of non-curricular learning strategies. *Journal of Curriculum and Instruction*, *7*(2), 38–55. [CrossRef]

Cornista, G. A., & Macasaet, C. J. (2013). *Adversity quotient® and achievement motivation of selected third year and fourth year psychology students of de la salle lipa AY 2012–2013* [Unpublished Undergraduate Thesis].

Covington, M. V. (1984). The self-worth theory of achievement motivation: Findings and implications. *The Elementary School Journal*, *85*(1), 5–20. [CrossRef]

Curry, L. (1983). An organization of learning styles theory and constructs. *Cognitive Style*, *28*, 28.

Demiroren, M., Turan, S., & Oztuna, D. (2016). Medical students' self-efficacy in problem-based learning and its relationship with self-regulated learning. *Medical Education Online*, *21*, 30049. [CrossRef]

Dorji, R., & Singh, K. (2019). Role of adversity quotient in learning. *International Journal of Education*, *11*, 119–125.

Dunn, K. E., Lo, W.-J., Mulvenon, S. W., & Sutcliffe, R. (2011). Revisiting the motivated strategies for learning questionnaire. *Educational and Psychological Measurement*, *72*(2), 312–331. [CrossRef]

Effendi, M., Matore, E. M., & Khairani, A. Z. (2016). Correlation between adversity quotient (AQ) with IQ, EQ and SQ among polytechnic students using rasch model. *Indian Journal of Science Technology*, *9*(47), 1–8. [CrossRef]

El-Adl, A., & Alkharusi, H. (2020). Relationships between self-regulated learning strategies, learning motivation and mathematics achievement. *Cypriot Journal of Educational Sciences*, *15*(1), 104–111. [CrossRef]

Ergen, B., & Kanadli, S. (2017). The effect of self-regulated learning strategies on academic achievement: A meta-analysis study. *Eurasian Journal of Educational Research*, *17*(69), 55–74. [CrossRef]

Eshel, Y., & Kohavi, R. (2010). Perceived classroom control, self-regulated learning strategies, and academic achievement. *Educational Psychology*, *23*(3), 249–260. [CrossRef]

Falk, R. F., & Miller, N. B. (1992). *A primer for soft modeling*. University of Akron Press.

Falkner, K., Vivian, R., & Falkner, N. J. G. (2014, June 21–25). *Identifying computer science self-regulated learning strategies*. 2014 Conference on Innovation & Technology in Computer Science Education—ITiCSE'14, Uppsala, Sweden.

Fitri, R. Y. (2017). The effect of problem-based learning model (PBL) and adversity quotient (AQ) on problem-solving ability. *American Journal of Educational Research*, *5*(2), 179–183.

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(3), 382. [CrossRef]

Han, J., & Lu, Q. (2017). A correlation study among achievement motivation, goal-setting and L2 learning strategy in EFL context. *English Language Teaching*, *11*(2), 5. [CrossRef]

Hastuti, T. D., Sari S, D. R., & Riyadi. (2018). Student profile with high adversity quotient in math learning. *Journal of Physics: Conference Series*, *983*, 012131. [CrossRef]

Hidayat, W., Noto, M. S., & Sariningsih, R. (2019). The influence of adversity quotient on students' mathematical understanding ability. *Journal of Physics: Conference Series*, *1157*(3), 032077. [CrossRef]

Hidayat, W., & Prabawanto, S. (2018). Improving students' creative mathematical reasoning ability students through adversity quotient and argument driven inquiry learning. *Journal of Physics: Conference Series*, *948*(1), 012005. [CrossRef]

Hong, W., Bernacki, M. L., & Perera, H. N. (2020). A latent profile analysis of undergraduates' achievement motivations and metacognitive behaviors, and their relations to achievement in science. *Journal of Educational Psychology*, *112*(7), 1409–1430. [CrossRef]

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1–55. [CrossRef]

Hulaikah, M., Degeng, I. N. S., Sulton, S., & Murwani, F. D. (2020). The effect of experiential learning and adversity quotient on problem solving ability. *International Journal of Instruction*, *13*(1), 869–884. [CrossRef]

Istiqomah, V., Astuti, B., & Sugiyanto, S. (2025). The impact of adversity quotient on students' problem-solving skills based on bransford-stein's theory. *Jurnal Pendidikan Fisika dan Teknologi*, *11*(1), 140–148. [CrossRef]

Jiang, L., Zhang, S., Li, X., & Luo, F. (2021). How grit influences high school students' academic performance and the mediation effect of academic self-efficacy and cognitive learning strategies. *Current Psychology*, *42*(1), 94–103. [CrossRef]

Jing, H. B. (2006). Confucian coping and its role to mental health. *Acta Psychologica Sinica*, *38*(1), 126–134.

Jöreskog, K. G., & Sörbom, D. (1993). *LISREL 8: Structural equation modeling with the SIMPLIS command language*. Scientific Software International.

Kil, H., O'Neill, D., & Grusec, J. E. (2021). Prosocial motivation as a mediator between dispositional mindfulness and prosocial behavior. *Personality and Individual Differences*, *177*, 110806. [CrossRef]

Kline, R. B. (1998). *Principles and practice of structural equation modeling*. Guilford Press.

Lin, S. H., & Chen, J. (2011). Adversity quotient and achievement motivation of college students in poverty. *Chinese Mental Health Journal*, *25*(9), 691–694.

McClelland, D. C., & Mac Clelland, D. C. (1961). *Achieving society* (Vol. 92051). Simon and Schuster.

McDonald, R. P., & Ho, M.-H. R. (2002). Principles and practice in reporting structural equation analyses. *Psychological Methods*, *7*(1), 64–82. [CrossRef]

Nahrowi, N., Susanto, S., & Hobri, H. (2020). The profile of student's creative thinking skills in mathematics problem solving in terms of adversity quotient. *Journal of Physics: Conference Series*, *1465*(1), 012064. [CrossRef]

Ochieng, P. A. (2009). An analysis of the strengths and limitation of qualitative and quantitative research paradigms. *Problems of Education in the 21st Century*, *13*, 13.

Phoolka, E. S. (2012). Adversity quotient: A new paradigm to explore. *International Journal of Contemporary Business Studies*, *3*(4), 67–78.

Pintrich, P. R. (1995). Understanding self-regulated learning. *New Directions for Teaching and Learning*, *1995*(63), 3–12. [CrossRef]

Purnamasari, F. E., Sujadi, I., & Slamet, I. (2019). Effect of adversity quotient of junior high school students on reflective thinking process in mathematical problem solving. *Journal of Physics: Conference Series*, *1321*, 022128. [CrossRef]

Ratna, H., Roemintoyo, R., & Usodo, B. (2020). The role of adversity quotient in the field of education: A review of the literature on educational development. *International Journal of Educational Methodology*, *6*(3), 507–515. [CrossRef]

Rotter, J. B. (1975). Some problems and misconceptions related to the construct of internal versus external control of reinforcement. *Journal of Consulting and Clinical Psychology*, *43*(1), 56–67. [CrossRef]

Safi'i, A., Muttaqin, I., Sukino, Hamzah, N., Chotimah, C., Junaris, I., & Rifa'i, M. K. (2021). The effect of the adversity quotient on student performance, student learning autonomy and student achievement in the COVID-19 pandemic era: Evidence from Indonesia. *Heliyon*, *7*(12), e08510. [CrossRef] [PubMed]

Sahin, U. (2019). Parents' participation types in school education. *International Journal of Educational Methodology*, *5*(3), 315–324. [CrossRef]

Sarstedt, M., & Mooi, E. (2014). *A concise guide to market research: The process, data, and methods using IBM SPSS statistics*. Springer.

Schoeps, K., Tamarit, A., Peris-Hernández, M., & Montoya-Castilla, I. (2021). Impact of emotional intelligence on burnout among spanish teachers: A mediation study. *Psicología Educativa*, *27*(2), 135–143. [CrossRef]

Sen, S., Yilmaz, A., & Yurdagül, H. (2014). An evaluation of the pattern between students' motivation, learning strategies and their epistemological beliefs: The mediator role of motivation. *Science Education International*, *25*(3), 312–331.

Sriyanti, M., Sulvianti, S., Rasmi, R., & A Andriani, Y. (2025). Exploring the impact of adversity quotient on students' mathematics achievement in junior high school. *Jurnal Pendidikan MIPA*, *26*(2), 1068–1085. [CrossRef]

Stoltz, P. G. (1997). *Adversity quotient: Turning obstacles into opportunities*. John Wiley & Sons.

Stoltz, P. G. (2010). *Adversity quotient work: Finding your hidden capacity for getting things done*. Harper Collins.

Suryaningrum, C. W., Purwanto, P., Subanji, S., Susanto, H., Ningtyas, Y. D. W. K., & Irfan, M. (2020). Semiotic reasoning emerges in constructing properties of a rectangle: A study of adversity quotient. *Journal on Mathematics Education*, *11*(1), 95–110. [CrossRef]

Tang, H., & Lu, N. (2013). Measure invariance research of the short form of achievement motive scale in boy-girl of middle school students in Shenzhen. *Advances in Psychology*, *3*(6), 321–326. [CrossRef]

Thomas-Francois, K., Jo, W., Somogyi, S., Li, Q., & Nixon, A. (2023). Virtual grocery shopping intention: An application of the model of goal-directed behaviour. *British Food Journal*, *125*(8), 3097–3112. [CrossRef]

Tian, Q., Fan, X., & Lyu, F. (2011). Study on relationships among adversity quotient, future time perspective and achievement motivation in college nursing students. *Journal of Nursing Science*, *26*(5), 7–10.

Wang, J., & Wang, X. (2019). *Structural equation modeling: Applications using Mplus*. John Wiley & Sons.

Wang, X., Yan, Z., Huang, Y., Tang, A., & Chen, J. (2022). Re-developing the adversity response profile for Chinese university students. *International Journal of Environmental Research and Public Health*, *19*(11), 6389. [CrossRef]

Weinstein, C. E., Acee, T. W., & Jung, J. (2011). Self-regulation and learning strategies. *New Directions for Teaching and Learning*, *2011*(126), 45–53. [CrossRef]

Weisskirch, R. S. (2016). Grit, self-esteem, learning strategies and attitudes and estimated and achieved course grades among college students. *Current Psychology*, *37*(1), 21–27. [CrossRef]

Yan, Z., & Mok, M. M. C. (2012). Validating the coping scale for Chinese athletes using multidimensional Rasch analysis. *Psychology of Sport and Exercise*, *13*(3), 271–279. [CrossRef]

Yodsakun, A., & Kuha, A. (2008). Relationship between emotional intelligence (EQ), adversity quotient (AQ) and moral quotient (MQ) towards academic achievement of mattayom suksa two students. *Journal of the Faculty of Education*, *19*(2), 129–142.

Yustiana, Y., Kusmayadi, T. A., & Fitriana, L. (2021). Mathematical problem solving ability of vocational high school students based on adversity quotient. *Journal of Physics: Conference Series*, *1806*(1), 012092. [CrossRef]

Zajacova, B. (2013). Learning styles in physics education: Introduction of our research tools and design. *Procedia-Social and Behavioral Sciences*, *106*, 1786–1795. [CrossRef]

Zhang, L. X., Yan, Z., & Wang, X. (2025). Understanding music teachers' formative assessment intention and implementation: A Chinese Mainland context. *International Journal of Music Education*. [CrossRef]

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2), 64–70. [CrossRef]