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ORIGINAL ARTICLE

Exploring the Impact of Growth Mindset on Mathematics Achievement, Attitudes and Anxiety in Middle School Students

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Ethical Statement
Voluntary consent forms were distributed to the participants and parental consent forms were distributed to their families and signed. They were informed about the general framework of the study and that they could leave the study at any time. Permission was obtained from the relevant institution (Ministry of National Education with MEB.TT.2024.001895) for the realization of the study.

Funding Information
No funding was received for the study.

Conflict of Interest
No conflict of interest is present in the conduction or the reporting of this study.

ABSTRACT

Why do some students give up immediately when faced with a difficult mathematics problem, while others persist in their efforts? Psychologist Carol Dweck, who researches how children overcome situations in which they fail, explains this phenomenon with "mindset theory." According to this theory, which posits that students' mindset structures greatly influence their learning processes, achievements, and general attitudes, individuals possess one of two different mindsets: "growth mindset" or "fixed mindset." Individuals with a fixed mindset believe that certain traits such as intelligence, talent, and character are unchangeable, while those with a growth mindset hold the opposite view. This study aimed to examine the impact of a growth mindset on mathematics achievement, academic perseverance, attitudes toward mathematics, and mathematics anxiety among 8th-grade students. A correlational survey model was employed, administering the Mathematical Mindset Theory Scale, Academic Perseverance Scale, Mathematics Lesson Attitude and Anxiety Scale, and a TIMSS-based Academic Achievement Test to 183 8th-grade students. The study also analyzed the relationship between student and parent mindset structures. Analyses revealed a significant positive relationship between a growth mindset and academic perseverance, mathematics attitudes, and mathematics achievement. Conversely, a significant negative relationship was found with mathematics anxiety. A further significant finding was that students of parents with a growth mindset were more likely to possess a growth mindset themselves. The findings underscore that non-cognitive factors, specifically a growth mindset, are critical components of mathematics learning, suggesting that interventions focused on fostering this mindset in students and parents may enhance academic success.

Keywords: Mindset Theory, Mathematics Education, Values, Patience, Learning Psychology.

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INTRODUCTION

"In mathematics, patience precedes intelligence." (Cahit Arf)

Mathematics is a systematic discipline fundamental to understanding natural phenomena and developing abstract thought. Its significance extends beyond scientific research, as it is essential for fostering the analytical thinking, problem-solving, and abstraction capabilities required in modern knowledge-based societies. The educational importance of mathematics is underscored by international assessments like PISA, where achievement levels correlate directly with a nation's technological competitiveness and potential for economic innovation. Beyond its academic role, mathematics also plays a critical part in daily life decision-making and modeling (Aghaei & Ahmadi, 2017; Işık, Çiltaş & Bekdemir, 2010; Tutak & Güder, 2014).

Students' attitudes towards mathematical problems are closely related to mindset theory. According to this theory, individuals' beliefs about intelligence and talent influence the effort and resilience they demonstrate in problem-solving processes. Developed by Carol Dweck, this theory posits that individuals can possess either a fixed mindset or a growth mindset (Dweck, 2006). Students with a fixed mindset believe that intelligence and abilities are innate and unchangeable. Such students tend to abandon challenges when they fail in mathematics, attributing their failure to a lack of inherent ability. They perceive mistakes as personal inadequacies and believe that exerting effort is futile (Boaler, 2016). Conversely, students with a growth mindset believe that success can be cultivated through effort and learning processes. When confronted with a mathematical problem, they view difficulties as opportunities for learning and persevere for longer durations. This type of mindset instills self-confidence in students, thereby providing motivation during problem-solving processes (Dweck, 2006). Furthermore, feedback from teachers and parents that praises effort and the learning process contributes to students' development of a growth mindset (Boaler, 2016).

Success in mathematics is not solely dependent on technical knowledge and skills; values and mental attitudes also play a substantial role. These values assist individuals in coping with difficulties and approaching the learning process more positively. In this context, values such as patience, perseverance, and self-confidence are prominently featured in the literature. Patience is critically important for overcoming difficulties in mathematics as it enhances mental resilience and ensures the continuation of long-term efforts. The concept of patience fosters a constructive attitude toward making and learning from mistakes – a natural and essential part of the learning process (Dweck, 2006). Success is the result of persistent effort. Particularly in mathematics, the perseverance demonstrated in solving a problem accelerates progress in the learning process. Duckworth and Quinn (2009) emphasized that individuals' perseverance is a critical factor in academic achievement. Believing in one's own abilities facilitates coping with difficulties in mathematics (Aronson at al., 2002; Pajares & Graham, 1999).

Table 1. Key Differences Between Fixed Mindset Students and Growth Mindset Students*

	Fixed Mindset Student	Growth Mindset Student
Perception of Success	They generally associate success with natural talent. If they are not successful in a subject, they believe it is due to their own lack of ability.	They associate success with effort and the learning process. They see their mistakes as opportunities to learn and focus on improvement.
Approach to Mistakes	They try to avoid mistakes; when they make mistakes, they perceive them as personal failures.	They view mistakes as valuable learning experiences and tend to learn lessons from these experiences.
Coping with Challenges	When faced with challenges, they may give up easily and feel inadequate.	They evaluate challenges as opportunities and tend to exert more effort.
Receiving Feedback	They generally perceive feedback as criticism and are uncomfortable with it.	They see feedback as a tool for learning and utilize this feedback as an opportunity for evaluation.
Source of Motivation	They tend to be motivated by external rewards for success.	They act with internal motivation, driven by a desire to learn and develop.

*Dweck, 2006; Dweck, C. S., & Leggett, E. L.,1988.

These differences substantially influence students' learning processes, achievements, and overall attitudes. Adopting a growth-oriented approach can enable students to be more flexible and resilient (Blackwell et al., 2007). Individuals with a growth mindset exhibit high academic perseverance; this allows students to strive in the face of challenges without giving up. Dweck (2012) indicated that this is a critical factor for students in achieving their goals and ensures sustainable progress in academic achievement. For instance, students with a growth mindset do not lose their motivation to learn when faced with failure and continue to contend with difficulties (Yeager & Dweck, 2012).

In the context of mindset theory, anxiety is a significant factor affecting students' success in mathematics education (Maloney & Beilock, 2012). Students with a fixed mindset, believing their intelligence is limited, experience greater anxiety due to the fear of failure when they encounter difficulties in mathematics, which adversely affects mathematics achievement (Dweck, 2006). These students are inclined to give up quickly when they struggle with mathematical problems, succumbing to a perception of a lack of ability (Boaler, 2016). In contrast, students with a growth mindset are more willing to exert greater effort and seek solutions to overcome anxiety, as they believe that difficulties are an integral part of the learning process (Yeager & Dweck, 2012). Research indicates that students with a growth mindset tend to view anxiety as a learning tool, thereby enabling them to maintain their academic performance (Dweck & Leggett, 1988).

Upon reviewing the relevant literature, it is evident that while the concept of mindset has been the subject of numerous studies, these investigations have predominantly focused on mindsets related to general intelligence. Dweck et al. (1995) suggested that mindset can be domain-specific; that is, an individual may possess a growth mindset in one area while having a fixed mindset in another. Studies on the role of a growth mindset in different domains, such as mathematics and foreign languages, are limited. In this context, the aim of the study is to examine the effect of mathematical mindset theory and academic perseverance on 8th-grade students' mathematics achievement, attitudes, and anxiety. According to the Research Hypothesis Model (Figure 1), it is predicted that all the aforementioned variables are interrelated. The research includes various analyses to determine whether this relationship exists.

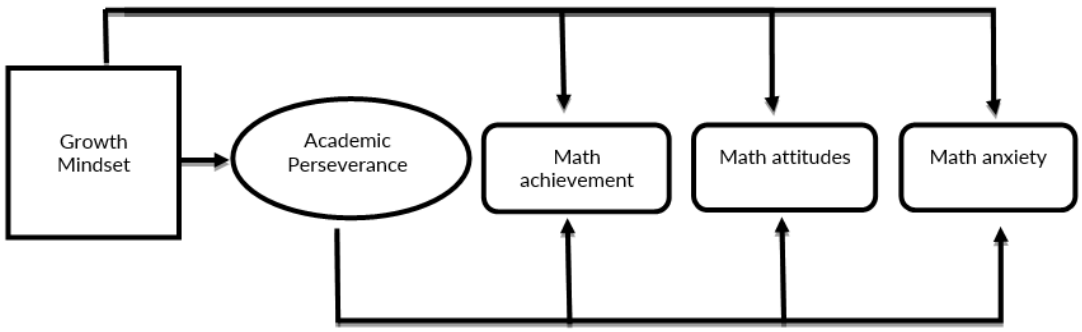

Figure 1. Research Hypothesis Model

METHOD

This section will cover the research model, sample, data collection tools, and data analysis.

Research Model

This study was designed using a correlational survey model. The correlational survey model is employed to determine whether a relationship exists between two or more measurable variables, and if so, to ascertain the degree and direction of this relationship (Walker, 2005). In this study, the mathematics achievement, attitude, and anxiety of 8th-grade students will be examined in relation to mathematical mindset theory and academic perseverance.

Sample

The sample of the study consists of 183 8th-grade students. Necessary permissions for the research were obtained (Appendix 1), and students' voluntary participation in the study was ensured.

Table 2: Distribution of Participating Students by Gender (8th Grade)

Gender	8. Grade (n)	Total (%)
Female	95	%51,90
Male	88	%48,10
Total	183	%100,0

According to Table 2, 51.90% (n=95) of the students participating in the research are female, while 48.10% (n=88) are male. Furthermore, the “Growth Mindset Scale” was also administered to the students' parents, and the responses were compared.

Table 3: Distribution of Mindset Structures of the Parents of Students Participating in the Research

Mindset Structure	Parent (n)	Total (%)
Growth Mindset	101	%55.19
Fixed Mindset	82	%44.81
Total	183	%100.0

According to Table 3, which presents the distribution of parents' mindset structures, 55.19% (n=101) of the participating parents have a growth mindset, and 44.81% (n=82) have a fixed mindset. The “Mathematical Mindset Scale” used for students was administered to the parents in its general form by removing the word “mathematics”. For example, one of the scale items, “You have a certain amount of mathematics intelligence, and you can’t really do much to change it,” was modified to “You have a certain amount of intelligence, and you can’t really do much to change it.”

Data Collection Tools

In this research, the mathematical mindset theory scale, academic perseverance scale, mathematics attitude scale, mathematics anxiety scale, and mathematics achievement test were used as data collection tools. Information regarding the developers of these instruments, the number of items, and sample items are presented in Table 4.

Table 4. Data Collection Tools Information

Name of the Scale	Source (Year) / Number of Items	Sample Items
Mathematical Mindset Theory Scale	Developed by Dweck (1999) and the scale was adapted to Turkish by Beyaztaş and Hymer (2018) / 6 Items / 6-point Likert scale	2- You have a certain amount of math intelligence, and you can't really do much to change it. 4- No matter who you are, you can significantly change your level of math intelligence. 5- You can always substantially change your level of

		math intelligence.
Academic Perseverance Scale	Developed by Clark and Malecki (2019) / 10 Items / 6-point Likert scale	4- No matter how hard it is, I complete my homework. 7- I can balance dedicating time to my hobbies and interests with studying hard for lessons. 10- I work very hard at school to achieve difficult goals.
Mathematics Attitude Scale	Sever (2014) / 19 Items / 5-point Likert scale	1-I like learning mathematics at school. 12- Even the thought of learning mathematics scares me. 17- Mathematics is one of the important subjects that people should learn.
Mathematics Anxiety Scale	Bindak (2005) / 10 Items / 5-point Likert scale	1-When I think of mathematics, complex and incomprehensible things come to mind. 3- I worry that I will always be asked questions in math classes. 10- I am afraid to ask questions in math class.

Mathematics Achievement Test (Appendix 2)

It is a 20-question test prepared by researchers, the supervising teacher, and 3 expert mathematics teachers, using questions from the International TIMSS (Trends in International Mathematics and Science Study) Exams of 2011 and 2015. Each question is worth 5 points, and the maximum achievable score is 100. In the TIMSS Exam, questions are classified into cognitive domains as "Knowing", "Applying" and "Reasoning" after chosen. In the prepared achievement test, 8 questions (40%) are at the knowing level, 9 questions (45%) are at the applying level, and 3 questions (15%) are at the reasoning level. According to content domains, 55% (n=11) of the questions were determined to be from numbers, 20% (n=4) from geometry, and 25% (n=5) from data. The questions in the test content were selected to be appropriate for the 8th-grade level, and students were given 30 minutes to complete the test.

Data Analysis

Descriptive statistics for academic perseverance, mathematical mindset, mathematics attitude, mathematics anxiety, and mathematics achievement were calculated, and normality analyses were also conducted. Skewness and kurtosis values were examined for normality (Table 5). Since the skewness and kurtosis values were between -1.5 and 1.5, parametric data analysis methods suitable for normal distribution were employed (Tabachnick & Fidell, 2007). The data obtained from the scales were transferred to the SPSS 23 software package and analyzed by using independent samples t-tests, correlation analysis for inter-scale relationships, and descriptive statistics.

Table 5. Descriptive Statistics, Skewness, and Kurtosis Values for the Scales

Scale	Mean	SD	Min.	Max.	Skewness	Kurtosis
Growth Mindset	3.4057	1.65	1.81	5.94	-0.22	1.15
Academic Perseverance	3.5989	1.42	3.02	5.34	0.01	1.51
Mathematics Attitude	2.8076	1.65	1.81	4.82	-0.83	1.32
Mathematics Anxiety	2.7787	0.83	1.81	4.91	-0.27	1.21
Mathematics Achievement	50.4568	5.41	15.02	95.34	-1.23	0.92

FINDINGS

In this section, first, item-by-item average tables of students' responses to the data collection instruments—namely the "Mathematical Mindset Theory Scale," "Academic Perseverance Scale," "Attitude Towards Mathematics Scale," and "Mathematics Anxiety Scale"—were created. Subsequently, the relationships among these were examined, and finally, the interrelationships among all scales were investigated.

Table 6. Averages of Student Responses to the Growth Mindset Theory Scale

Growth Mindset Theory Items	M*
1. You have a certain amount of math intelligence, and there isn't much you can do to change it.	3.58
2. Your math intelligence is something about you that you can't change very much.	3.30
3. You can learn new things, but you can't change your basic level of math intelligence.	3.37
4. No matter who you are, you can significantly change your level of math intelligence.	3.50
5. You can always substantially change your level of math intelligence.	3.49
6. No matter how much math intelligence you have, you can always change it quite a bit.	3.17
Scale Mean	**3.40**

(1) Strongly disagree, (2) Disagree, (3) Mostly disagree, (4) Mostly agree, (5) Agree, (6) Strongly agree

Upon examining Table 6, which presents students' responses to the Growth Mindset Theory Scale, it was observed that the students' overall mean score was 3.40. This value is slightly below the theoretical midpoint of 3.5 for a 6-point Likert scale, suggesting a predominantly neutral or mixed mindset. When the items are examined, the highest mean score (*M* = 3.58) was for the fixed-mindset item, 'You have a certain amount of math intelligence, and there isn't much you can do to change it.' Conversely, the lowest score (*M* = 3.17) was for the growth-mindset item, 'No matter how much math intelligence you have, you can always change it quite a bit.' This suggests a level of uncertainty or passivity among students regarding their capacity for intellectual growth in mathematics.

Table 7. Averages of Student Responses to the Academic Perseverance Scale

Academic Perseverance Items	*M*
1. I push myself at school to do my best.	3.75
2. No matter how long it takes, I continue to work to achieve my academic goals.	3.54
3. Even when I could be doing more fun things, I try as hard as I can regarding my studies.	3.52
4. No matter how hard it is, I complete my homework.	3.50
5. I try to do my best for my lessons.	4.03
6. When I set a school-related goal, I strive to overcome any difficulties that arise.	3.56
7. I can balance dedicating time to my hobbies and interests with studying hard for lessons.	3.43
8. Even if I struggle at school, I continue to do my best.	3.47
9. I always strive to do my best in finishing schoolwork.	3.65
10. I work very hard at school to achieve difficult goals.	3.48
Scale Mean	**3.59**

(1) Strongly disagree, (2) Disagree, (3) Mostly disagree, (4) Mostly agree, (5) Agree, (6) Strongly agree

An examination of Table 7, which presents students' responses to the Academic Perseverance Scale, reveals that the overall mean academic perseverance score of the students is 3.59. This value indicates a perseverance level above the average. The item with the highest perseverance score is "I try to do my best for my courses" (*M* = 4.03). Conversely, the item reflecting the lowest level of perseverance is "I can balance spending time on my hobbies and interests with studying hard" (*M* = 3.43). It is noteworthy that this item's score falls below the overall mean.

Table 8. Mean Scores of Student Responses to the Mathematics Anxiety Scale

Mathematics Anxiety Scale Items	X
1-When I think of mathematics, complex and incomprehensible things come to mind.	2.84
2-I find it difficult to go to the board during mathematics lessons.	2.63
3-I am always anxious that I will be asked a question in mathematics lessons.	2.77
4-I understand mathematics now, but I am worried that it will become progressively more difficult.	2.74
5-I am not as afraid of anything else as I am of mathematics exams.	2.84
6-I am afraid that I will not be able to pass my grade because of mathematics.	2.76
7-When I enter a mathematics lesson, I feel overwhelmed by fear.	2.56
8-I do not know how to study for mathematics exams.	2.79
9-For me, mathematics is very enjoyable (reverse coded).	3.25

10-I am afraid to ask questions in mathematics class.		2.33
	Mean:	**2,77**

(1) Strongly disagree, (2) Disagree, (3) Mostly disagree, (4) Mostly agree, (5) Agree, (6) Strongly agree

Upon examination of Table 8, which presents the students' responses to the Mathematics Anxiety Scale, it was observed that the students' overall mean anxiety score is 2.77. This value is slightly below the theoretical neutral midpoint of 3.0 for a 5-point Likert scale, suggesting that students, on average, lean slightly towards disagreeing with anxiety-inducing statements, though the score remains very close to neutral. The items indicating the highest levels of anxiety among students were identified as: "When I think of mathematics, complex and incomprehensible things come to mind." (X =2.84) and "I am not as afraid of anything else as I am of mathematics exams." (X =2.84). Furthermore, the score for the only reverse-coded item on the scale, "For me, mathematics is very enjoyable." (X =3.25), has been adjusted accordingly. The statement with which students reported the least anxiety was "I am afraid to ask questions in mathematics class." (X =2.33). The value for this item is below the mean.

Table 9. Mean Scores of Student Responses to the Mathematics Attitude Scale

Mathematics Attitude Scale Items		**M**
1-I enjoy learning mathematics at school.		2.84
2-I enjoy solving different problems in mathematics class.		2.96
3-I genuinely like mathematics lessons.		2.78
4-I am happier in mathematics lessons than in other lessons.		2.53
5-Mathematics is a very interesting subject.		3.02
6-I am confident that I can learn difficult topics in mathematics.		2.64
7-I want to learn more than what is taught in mathematics class, even if it is difficult.		2.31
8-I plan to take more mathematics courses in my academic life.		2.37
9-I enjoy the challenging nature of mathematics lessons.		2.02
10-I feel stressed and tense when studying mathematics.		2.76
11-I always feel under pressure in mathematics class.		3.05
12-Even the thought of learning mathematics makes me anxious.		3.27
13-I always get confused in mathematics class.		2.62
14-I feel that I lack confidence when learning mathematics.		2.84
15-Mathematics is an important and necessary subject.		3.13
16-What I learn in mathematics class appears in daily life.		3.09
17-Mathematics is one of the important subjects that people should learn.		3.12
18-I believe that mathematics lessons will be beneficial regardless of my future field of study.		2.87
19-Having a good foundation in mathematics will help me in my future professional life.		3.05
	Mean:	2.80

(1)Strongly disagree, (2) Disagree, (3) Undecided, (4) Agree, (5) Strongly agree

Upon examination of Table 9, which presents the students' responses to the Mathematics Attitude Scale, it was observed that the students' overall mean attitude score is 2.80. This value falls just below the theoretical neutral midpoint of 3.0 for a 5-point Likert scale, indicating that the students' collective attitude towards mathematics is slightly negative, or at best, neutral-to-negative. The item indicating the highest level of positive attitude among students was identified as: "Mathematics is one of the important subjects that people should learn." (*M* =3.12). Furthermore, the scores for the reverse-coded items on the scale, namely "I feel stressed and tense when studying mathematics." (*M* =2.76), "I always feel under pressure in mathematics class." (*M* =3.05), "Even the thought of learning mathematics makes me anxious." (*M* =3.27), and "I feel that I lack confidence when learning mathematics." (*M* =2.84), have been adjusted. The statement with which students reported the least positive attitude was "I enjoy the challenging nature of mathematics lessons." (*M* =2.02); findings indicated that the value for this item is below the average, indeed considerably low.

Table 10. Comparison of Scale Item Scores by Student Gender

Measured Variable	Gender	N	Mean	SD	SEM	*t*	*p*
Achievement Score	Female	95	52.780	24.600	2.524	1.21	0.229
	Male	88	48.384	24.700	2.633		
Growth Mindset	Female	95	3.3593	1.110	0.114	-0.55	0.580
	Male	88	3.4508	1.120	0.119		
Academic Perseverance	Female	95	1.0141	0.400	0.041	0.69	0,490
	Male	88	0.9725	0.410	0.044		
Mathematics Attitude	Female	95	2.7990	0.760	0.078	-0.08	0,932
	Male	88	2.8086	0.770	0.082		
Mathematics Anxiety	Female	95	2.7158	0.950	0.097	-0.51	0,612
	Male	88	2.7875	0.960	0.102		

Independent samples t-test analyses were conducted to examine whether statistically significant differences exist between the mean scores of female (N=95) and male (N=88) students on various scale items, as presented in Table 10. Regarding the achievement score variable, although female students' mean (M=52.78, SD=24.60) was higher than that of male students (M=48.38, SD=24.70), this difference was not found to be statistically significant (*t*(181)=1.21, p=0.229). Similarly, no statistically significant differences were detected between female and male students in terms of growth mindset scores (Female: M=3.36, SD=1.11; Male: M=3.45, SD=1.12), academic perseverance scores (Female: M=1.01, SD=0.40; Male: M=0.97, SD=0.41), mathematics attitude scores (Female: M=2.80, SD=0.76; Male: M=2.81, SD=0.77), and mathematics anxiety scores (Female: M=2.72, SD=0.95; Male: M=2.79, SD=0.96) (for growth mindset, *t*(181)=-0.55, p=0.580; for academic perseverance, *t*(181)=0.69, p=.490; for mathematics attitude, *t*(181)=-0.08, p=0.932; for mathematics anxiety, t(181)=-0.51, p=.612). The p-values obtained in all these comparisons being greater than the conventionally accepted alpha level of 0.05 indicates that there are no statistically significant differences between students' genders concerning these five examined characteristics.

Table 11. The Relationship Between Growth Mindset and Achievement, Anxiety, and Attitude

		Growth Mindset	Achievement	Anxiety	Attitude
Growth Mindset	Correlate	1			
	p				
	n	183			
Achievement	Correlate	0,505*	1		
	p	0,001			
	n	183	183		
Anxiety	Correlate	-0,572*	-0.748*	1	
	p	0,001	0,001		
	n	183	183	183	
Attitude	Correlate	0,590*	0,598*	-0,642*	1
	p	0,001	0,001	0,001	
	n	183	183	183	183

Upon examining the data presented in Table 11, it was observed that growth mindset has a strong positive relationship with achievement (r = .505, p < .05) and attitude (r = .590, p < .05) while a strong negative relationship was found with anxiety (r =-.572, p<0.05). It can be stated that students with a growth mindset tend to exhibit higher achievement and more positive attitudes, alongside lower levels of anxiety. Furthermore, while strong negative relationships were observed between anxiety and achievement, and between anxiety and attitude, a strong positive relationship was found between achievement and attitude. *Based on these findings, students with a growth mindset exhibit*

lower anxiety towards mathematics lessons while demonstrating more positive attitudes towards the subject. Additionally, it is observed that the mathematics achievement of these students is correspondingly higher, in relation to their attitudes and anxiety levels.

Table 12. The Relationship Between Academic Perseverance and Growth Mindset, Achievement, Anxiety, and Attitude

		Growth Mindset	Achievement	Anxiety	Attitude
Academic Perseverance	Korelasyon	0,499	0,754*	-0,619*	0,573*
	Anlamlılık	0,001	0,001	0,001	0,001
	N	183	183	183	183

According to Table 12, which examines the relationship of academic perseverance with student achievement, anxiety, and attitude, as students' academic perseverance towards mathematics lessons increases, their attitudes and consequently their achievement increase, while their anxiety levels decrease ($r_{achievement}$=0.754; $r_{attitude}$=0.573; and $r_{anxiety}$=-0.619; $p_{anxiety}$=0.001, $p_{achievement}$=0.001, and $p_{attitude}$=0.001; p<0.05). Furthermore, when examining the relationship with academic perseverance for students who possess a growth mindset, a positive ($r_{growth\ mindset}$= .499) and significant ($p_{growth\ mindset}$= 0.001, which is p<0.05) relationship is observed. In other words, students with a growth mindset possess higher academic perseverance.

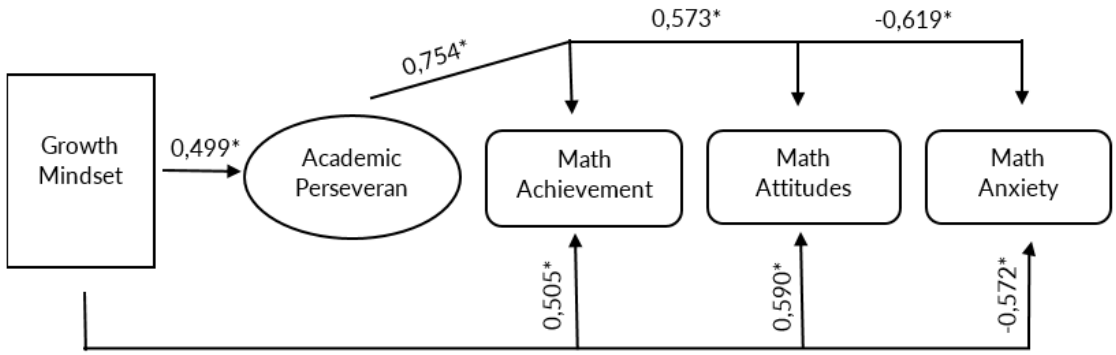

Figure 2. Simplified Final Model of the Relationships Among Measured Variables

Table 13. Comparison of Students' Mean Mindset Scores Based on Their Parents' Mindset Structure

Measured Value		N	Ortalama	P
Parent's Mindset Structure	Growth Mindset	101	4,32	**0,023**
	Mixed Mindset	82	2,48	

According to Table 13, which examines students' mindset structures based on whether their parents possess a growth mindset, the mean mindset score of children whose mothers have a growth mindset is 4.32, whereas the mean mindset score of children whose parents have a fixed mindset is 2.48. It is observed that there is a statistically significant difference (p=.023, p < .05) in the mindset scores of children depending on whether their parents have a growth mindset or a fixed mindset.

CONCLUSION AND DISCUSSION

This study investigated the relationships between growth mindset, academic perseverance, mathematics achievement, attitude, and anxiety among 183 8th-grade students.

The findings revealed that students with a growth mindset demonstrate higher academic perseverance and mathematics achievement. This outcome is consistent with Dweck's (2006) theory: when students believe their abilities can be developed, they exert more effort and become more resilient. Students with a growth mindset view failure as a learning opportunity, strengthening their academic perseverance. The research also confirmed that in subjects requiring problem-solving skills, such as mathematics, students' mindset structures significantly affect their anxiety levels and attitudes.

A noteworthy finding of the present study is the absence of statistically significant differences between female and male students across all measured variables: mathematics achievement, growth mindset, academic perseverance, mathematics attitude, and mathematics anxiety. This result is particularly compelling. While some literature suggests potential gender disparities, particularly in mathematics anxiety or self-efficacy, our findings align with a growing body of research indicating that gender differences in mathematics performance and motivation are diminishing or non-existent, especially in early adolescence (Hyde et al., 2008; Else-Quest et al., 2010). This non-significant finding suggests that at the 8th-grade level, psychological constructs such as growth mindset and academic perseverance may be far more dominant predictors of academic outcomes than gender, minimizing traditional gender gaps.

The findings also highlighted the significant positive relationship between mathematics attitude and achievement. While mathematics is often perceived as difficult, students with a growth mindset view challenges as surmountable obstacles. This fosters a more positive attitude that is decisive for achieving long-term learning goals. These results align with previous research, such as Ünal et al. (2020), which also found a significant relationship between students' attitudes and their achievement.

A final, crucial finding of this study is the significant relationship identified between parent and child mindset structures. Children of parents classified with a growth mindset held a significantly stronger growth mindset themselves, compared to children of parents with a fixed mindset. This highlights the critical role of the home environment in the socialization of students' beliefs about intelligence. Research suggests this transmission occurs through parental feedback; parents with a growth mindset are more likely to praise effort and strategy (process praise) rather than innate talent (person praise), which is a key factor in cultivating a growth mindset in children (Gunderson et al., 2013). Moreover, parents' own beliefs about the nature of failure—whether they view it as debilitating or as a learning opportunity—are strongly communicated to their children, directly shaping the child's own motivational framework (Haimovitz & Dweck, 2016). This finding provides strong empirical support for the recommendations aimed at parents, suggesting that interventions are most effective when they involve the entire family ecosystem.

Recommendations

The findings clearly indicate the importance of having a growth mindset for mathematics achievement. In this regard, the following recommendations are provided for teachers and parents to develop students' growth mindsets.

Recommendations for Future Research

Several limitations of this study should be acknowledged, which also provide avenues for future research. First, the study employed a correlational survey model, While this design successfully identified significant relationships between growth mindset, academic perseverance, achievement, attitude, and anxiety, it does not allow for the establishment of causality. The proposed hypothesis model (Figure 1) could be more robustly tested using advanced statistical methods. Therefore, future research is recommended to utilize structural equation modeling (SEM) or regression analyses to examine the direct and indirect predictive power of these variables on mathematics achievement.

Second, this study relied exclusively on quantitative data. To gain a deeper, more nuanced understanding of how students experience these psychological factors, future studies could employ a mixed-methods design, incorporating qualitative inquiries—such as open-ended questions or interviews—to explore the specific strategies students with a growth mindset use when facing mathematical challenges.

Recommendations for Teachers

Teachers should emphasize to students that abilities are not fixed and can be developed with effort and correct strategies. This includes creating a classroom environment where students are not afraid to make mistakes, seeing them instead as learning opportunities. Teachers can share stories of perseverance and praise student effort (e.g., "The effort you put into solving this problem was great") rather than innate intelligence (e.g., "You are very intelligent") . Furthermore, for students experiencing anxiety, teachers can introduce distraction techniques (e.g., breathing exercises) and foster positive attitudes through collaborative group work .

Recommendations for Parents

Parents should frequently remind their children that effort and the learning process are more important than innate intelligence or talent. When children struggle with mathematics, it should be explained that this is a temporary situation that can be overcome with practice, not a personal shortcoming. It is crucial to be encouraging in situations of failure and to motivate them to try new solutions. When a child struggles, parents should express trust, using encouraging phrases like, "This may seem difficult, but if you work at it, you can solve it," instead of "You can't do this" .

A growth mindset can be fostered by celebrating every step of the learning process, not just high achievement or exam scores. Parents should provide positive experiences related to mathematics, for example, by encouraging its use in daily life or playing fun math-related games. Furthermore, parents should model an open attitude toward learning new things themselves and explain to their children how they cope with difficulties in their own daily lives.

General Recommendations

To effectively foster a growth mindset, collaboration between educators and families is essential. An effective communication channel should be established between teachers and parents to jointly support students' mathematics achievement. This partnership can be strengthened through training programs designed to create awareness among both parents and teachers about the importance of a growth mindset. Concurrently, this approach should be reinforced within the classroom by organizing activities in mathematics lessons specifically designed to encourage perseverance, determination, and an openness to learning in students.

In summary, the findings emphasize that fostering a growth mindset is critical, as it not only enhances mathematical achievement but also reduces anxiety and promotes perseverance. Educators and families must collaborate to teach students that abilities can be developed and that failure is a natural part of learning, which can be overcome with sufficient effort and strategic approaches.

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