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Factors Influencing Mathematics Achievement among School Students (2015-2025): A Systematic Review

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Abstract: The present study focused on a systematic review on mathematics achievement. The systematic review was conducted to summarize evidence on various factors of students' mathematics achievement of school students from 2015 to 2025 by using the PRISMA framework. For this study, a systematic search was conducted by using the Scopus database which yielded 416 studies. Out of 416 studies, 46 studies were selected for full-text review. Out of 46 studies, 16 were excluded after being manually read, as these papers did not meet the objectives of the study. Thus, 30 studies were included for final analysis. The findings of the study revealed that psychological factors are the dominant factors that influence the level of mathematics achievement. Other factors are socioeconomic conditions and instructional strategies. The contribution of psychological factors and student-related factors, such as student engagement and instructional practices, was found to be important factors of students' mathematics achievement. Family, social, and school factors in learning significantly influence learning outcomes in mathematics among school students. Effective use of digital tools by the teacher has contributed positively to mathematics achievement. It was seen that students' mathematics achievement was negatively affected by the disruption of education during the COVID-19 pandemic. The findings from these 30 studies show that mathematics achievement is best

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improved through a holistic, adaptive and inclusive approach that helps learners succeed both academically and in life.

Keywords: Instructional Practices; Mathematics Achievement; Psychological Factors; School Students; Socioeconomic Factors; Systematic Review

1. Introduction

Mathematics achievement is viewed as an important indicator of students' academic achievement and is a key factor in national growth in the 21st century. Education systems worldwide are very interested in students' performance in mathematics. The emphasis on improving students' performance in mathematics is due to the belief that mathematical competence is necessary for participating in the knowledge economy and for developing the fields of science, technology, engineering, and mathematics (STEM). Due to this, much research has been done on trends and factors impacting student mathematics achievement in various contexts and across all levels of education. The most recent research shows that there are many cognitive, psychological, social, and environmental factors influencing student mathematics achievement.

Psychological factors are the most important. It appears that the student's self-concept serves as a mediator between achievement and their emotions as reflected by their enjoyment and anxiety in the mathematics (Van Der Beek et al., 2017). In addition, emotional intelligence, self-esteem and self-efficacy have been shown to be significant predictors of academic performance in mathematics. These affective components of mathematics education are thus very important (Ugwuanyi et al., 2020). Furthermore, mathematics anxiety has consistently been significantly correlated with lower levels of mathematics achievement, as emotional barriers have been shown to have a negative impact on student performance in the mathematics (Yarkwah et al., 2024).

Student factors, such as student engagement, play a crucial role in students' achievement in mathematics. Some past studies show that student engagement consists of three dimensions, namely, cognitive, behavioral, and affective. It significantly influences the learning outcomes of students, with affective engagement proving to be the greatest predictor of students' success (Maamin et al., 2021). Motivation, interest and social goal orientation all have a positive impact on students' academic success, reinforcing the need for learner-centered instructional practices (Boadu & Boateng, 2024; Wole et al., 2025).

Students' mathematics achievement is also significantly affected by family and social contexts. For example, parental involvement, especially through open and meaningful communication, has been associated with improved student performance in mathematics. Parental involvement can vary based on students' demographic backgrounds (Howard et al., 2023). Socioeconomic status, parental involvement, and peer effects have an impact on the achievement gaps in mathematics. This shows the importance of external support in students' academic achievement (Morgan et al., 2023; Sapazhanov et al., 2020). Students'

mathematics achievement continues to show a high degree of inequity among the different types of students.

The effectiveness of teaching practices and the quality of instruction that students are experiencing at the school level affect their level of success in mathematics. There are several factors that impact the quality of teaching in mathematics and how effective it is in helping students achieve academic success. Differentiated instruction helps the students to improve in their area of study. Boadu and Boateng (2024) have shown that effective teaching includes using technology, encouraging collaboration among peers, and using various sources of information other than textbooks to motivate students to learn.

In addition, teacher factors have a significant influence in determining how a student will become successful in achieving the goals, i.e., teacher clarity, classroom management, teacher effectiveness, etc. The mathematics achievement trend has also been affected by global disruption in recent times. The COVID-19 pandemic has brought upon us a more troubling time due to the lack of interaction among peers and the lack of engagement and delivery methods used in teaching mathematics (i.e., online versus in-person). All of the above factors provide support for the need to have an adaptive and resilient educational system for students to continue learning.

Some longitudinal and large-scale research has been able to prove that the greatest predictors of how a person will do well in mathematics in the future will be based on their previous achievements in mathematics, with respect to other factors such as cognitive ability, learning strategy, and classroom environment will also have a gradual effect over time (Lavelle-Hill et al., 2024; Stelzer et al., 2024). This aspect of mathematics achievement demonstrates the different factors that can contribute to achievement in mathematics.

The study is based on four research questions.

1. What are the key trends in research on students' mathematics achievement among school students during the period 2015–2025?
2. How do psychological and student-related factors influence students' mathematics achievement?
3. How do family, social, and school-related factors affect students' mathematics achievement?
4. How are instructional practices, technology integration, and recent developments affecting the students' mathematics achievement after COVID-19?

The current study provides a systematic literature review identifying trends and characteristics that affect mathematics achievement for K-12 students between 2015 and 2025 through a synthesis of existing empirical research. This review is intended to support a comprehensive understanding of the various factors affecting mathematics achievement.

2. Literature Review

Mathematics achievement has been extensively studied as a multidimensional construct influenced by a wide range of interrelated factors. Recent literature (2015–2025) highlights emerging trending factors across psychological, behavioral, social, and instructional domains, reflecting a shift toward more holistic and integrative perspectives. Recent studies and some learning theories show that learning potential affects math achievement. There is a strong positive relationship between self-efficacy and achievement in mathematics. Many studies indicate that students are likely to achieve at a higher level if they have a belief that they can do mathematics (Liu et al., 2024; Skaalvik et al., 2015; Yang et al., 2024). Self-beliefs and self-regulation are also important social cognitive theories of mathematics achievement (Kitsantas et al., 2011).

According to the expectancy-value theory, students are likely to perform better in mathematics when they expect to do well in the subject and when they regard this subject as a worthwhile (Fong & Kremer, 2020; Meyer et al., 2019). Students are likely to be engaged in and successful with mathematics when they have an autonomous motivation and a sense of competence (Lv et al., 2019; Wang et al., 2022), according to self-determination theory. All of this research suggests that self-efficacy, motivation, expectancy, and perceived competence are strong predictors of mathematics achievement.

2.1. Psychological and Affective Factors

Psychological factors have been shown to reliably predict mathematics achievement for students. Among these psychological factors, one of the most important factors is how well students perceive their own abilities, as it affects their experience of learning as well as how successful they are at performing different kinds of tasks. It has been found that the self-concept in mathematics has an effect on the relationship between students' emotional state (e.g., anxiety vs. enjoyment) and their level of mathematics achievement (Van Der Beek et al., 2017).

Furthermore, students' emotional intelligence, self-esteem, and self-efficacy are additional significant factors that influence the students' performance in mathematics, as it is indicated that students with greater emotional self-regulation and cognitive self-regulation achieve in mathematics at higher rates than students who do not have these characteristics (Van Der Beek et al., 2017). Another significant affective factor that impacts students' achievement in mathematics is anxiety. Anxiety has been related to lower levels of mathematics achievement, especially for students with low levels of achievement (Anbar et al., 2022; Yarkwah et al., 2024). There are also several motivational constructs (e.g., interest, identity, and expectation) that have been demonstrated to predict mathematics achievement across all grade levels (Bohrnstedt et al., 2024). The results of all the studies highlight the importance of creating positive emotional and motivational conditions within a mathematics classroom.

2.2. Student Engagement and Behavioral Factors

Recent studies have demonstrated that students' levels of engagement in school are significant predictors of overall mathematics achievement. Engagement is generally understood to include three overlapping components: cognitive engagement, behavioral engagement, and affective engagement. Each of these three types of student engagement positively correlates with academic achievement in mathematics. However, the evidence indicates that affective engagement, e.g., how a student feels about being engaged in the learning process, is the strongest predictor of mathematics achievement (Maamin et al., 2021).

The student behaviors related to their learning, including help-seeking and goal orientation, contribute positively toward students' mathematics achievement (Wole et al., 2025). In addition, the use of collaborative learning strategies and student-centered learning approaches has also been found to increase student engagement and therefore improve overall academic performance (Boadu & Boateng, 2024). As a result, research has clearly shown the importance of actively participating in the learning process and being involved in meaningful ways to increase students' academic success in mathematics.

2.3. Family, Socioeconomic, and Social Factors

Students' achievement in mathematics depends upon the family background and social context of the environment; both are important factors. Parental support and encouragement can help students achieve academically, but it does appear that the extent of parental involvement influences the academic success of different groups of students to varying degrees (Howard et al., 2023). Students who come from higher socioeconomic statuses (SES) tend to perform better academically than their peers. This may be attributed to the resources available to these students and the supportive educational settings provided (Morgan et al., 2023).

Another impact on students' academic performance is found through peer relationships and social relationships. Peer interactions, both formal and informal, are responsible for improving how students learn and understand the mathematics (Sapazhanov et al., 2020). However, regardless of these positive attributes, students have not experienced equal benefits based on demographics, race, ethnicity, or social backgrounds; therefore, again, equity in education is still a priority for these students.

2.4. Instructional and School-Related Factors

The instructional methods delivered in schools and the environment of schools influence positively or negatively the performance of the students. Numerous studies conducted by researchers have shown that differentiated instructional programs can meet the varied needs of all types of students and can result in higher levels of mathematical achievement (Bal, 2016). It has found that the strongest predictor of student achievement in mathematics is the use of digital resources as well as technology in both the classroom and at home (Joshi et al., 2025). In addition to these instructional strategies, teachers have an important role when it comes to student performance in mathematics through the way that they deliver their instruction, manage their classrooms, and provide quality teaching

(Asp et al., 2025). Innovative teaching practices such as using online lesson study have also produced positive results with teacher development and student achievement (Gao et al., 2025). Overall, these studies demonstrate that schools must use effective teaching strategies and offer supportive environments in order to support mathematics achievement.

2.5. Cognitive and Prior Achievement Factors

Cognitive ability and previous experience are two of the best indicators for achievement in mathematics. Numerous studies have shown that students with prior math success generally do better in mathematics, as their prior achievement typically will have a greater impact than other factors (Lavelle-Hill et al., 2024). Additionally, general cognitive capabilities, such as working memory and fluid intelligence, help enable students to solve mathematical problems and comprehend complicated mathematical ideas (Stelzer et al., 2024). Mathematical reasoning and higher-order thinking skills have demonstrated strong correlations with overall academic achievement in mathematics, indicating the significance of building cognitive abilities as part of a mathematics education (Alharbi & Aldhafiri, 2024).

2.6. Emerging Trends: Technology and COVID-19 Impact

In recent years, a trend has emerged in mathematics education research focusing on the impact of technology and global disruptions on students' mathematical learning outcomes. The use of digital technologies within the context of curricular instruction has significantly enhanced student mathematics achievement, as evidence in the literature shows (Joshi et al., 2025). A large-scale study of K-3 students' mathematics performance due to the COVID-19 pandemic has revealed significant declines in the mathematics achievement levels of the students. The research has identified a significant decline in achievement as a result of diminished teacher-student interaction, a lack of student motivation, and changes in the students' learning environment (Moliner et al., 2022). Such findings emphasize the need for resilient and flexible education systems that can face such major disruptions.

The significance of mathematics achievement involves shaping a student's ability to employ logical reasoning and impacting their success in academic life. In addition to shaping academic success, mathematics achievement shapes students' future interest in pursuing broader careers relating to STEM. Numerous studies reviewed in this paper demonstrated that factors representing student psychological, family, social, instructional, and technological environments impact mathematics achievement. It includes such factors as student mathematics anxiety, student self-efficacy in regard to mathematics, student motivation, parental involvement, teacher quality, and classroom environment.

The present study addresses gaps; for example, developing effective instructional strategies to improve student success in mathematics is dependent on understanding issues affecting mathematics achievement. While many studies focus on secondary school learners and use correlational research designs, fewer examine primary school learners, foundational numeracy, or innovative approaches such as multisensory teaching, particularly within the Indian context

of NEP 2020 and NIPUN. Understanding the factors that influence mathematics achievement is therefore important for all stakeholders, and this study investigates these factors and identifies effective teaching strategies to improve mathematics learning.

3. Methodology

Systematic reviews demand concise and precise reporting to ensure clarity, transparency, and ease of critical appraisal (Chien & Khan, 2023). Systematic literature reviews are conducted using structured and transparent procedures to synthesize existing evidence and minimize bias (Moher et al., 2009). The PRISMA framework further enhances the quality of reporting by ensuring clarity, reproducibility, and methodological rigor in review studies (Liberati et al., 2009).

The study followed a systematic review approach using the PRISMA guidelines to ensure transparency and adherence to systematic review guidelines. An extensive search of the literature was performed through the Scopus database. The initially identified search string yielded 416 articles after using an accurate Boolean search string that combined a variety of terms relating to (1) mathematics achievement; (2) factors that may affect mathematics achievement; and (3) school students. The methodology of the study followed a multi-phase screening approach compliant with PRISMA criteria for literature searches and screening.

3.1 Search Boolean String

Table 1 explains that on March 21, 2026, the Scopus database was searched using a structured Boolean search string, which gave 416 results, and showed that there are a significant number of research studies on mathematics achievement.

Table 1: Search Boolean String Used in Scopus Database

Search Query	Date of Search	Results Retrieved
(TITLE-ABS-KEY ("mathematics achievement" OR "math achievement" OR "academic achievement in mathematics")) AND (TITLE-ABS-KEY ("factor" OR "determinant" OR "predictor")) AND (TITLE-ABS-KEY ("school student" OR "student" OR "learner")) AND (TITLE-ABS-KEY ("school education" OR "primary school" OR "secondary school" OR "elementary school" OR "high school"))	21/03/2026	416

3.2 Inclusion and Exclusion Criteria

Table 2 depicts the inclusion and exclusion criteria of the article for the systematic literature review. To ensure that the articles included in this review meet high standards of quality and relevance, the selection process had well-established inclusion as well as exclusion criteria.

Table 2: Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Initial Search Scope	Studies containing keywords related to mathematics achievement, factors/determinants, and school students in the school education context	Studies not related to mathematics achievement, non-school populations, or unrelated domains
Publication Year	Studies published between 2015 and 2025	Studies published before 2015 or after 2025
Subject Area	Studies in Social Sciences and Mathematics	Studies from other subject areas (e.g., medicine, engineering, business, etc.)
Document Type	Research articles only	Conference papers, reviews, book chapters, editorials, notes, etc.
Language	English language publications	Non-English publications
Keyword Refinement	Studies with relevant exact keywords such as "Mathematics Achievement," "Students," "Academic Performance," etc.	Studies lacking relevant or aligned keywords
Publication Stage	Final published articles	Articles in press, articles in review, or incomplete publications
Accessibility	Open Access articles are available in full text	Closed access articles or those without full-text availability
Manual Screening (Full-Text Review)	30 articles retained after careful reading; studies directly aligned with research scope and research questions	16 articles were excluded as they were out of context, not aligned with the study objectives, or did not adequately address factors influencing mathematics achievement

The review began with the identification of studies that examined mathematics achievement and the factors that influence it among school-age youth. The use of filters (e.g., publication timeframe: 2015–2025; subject area: social sciences or mathematics; document type: peer-reviewed; language: English; publication stage: final article) allowed for narrowing down the available literature.

3.3 PRISMA Guideline for Article Screening

Figure 1 depicts the PRISMA guideline in screening different studies based on the criteria and objective of the study. The researcher got a total of 46 papers. This process ultimately led to the retention of 30 articles through manual full-text review, while 16 were excluded due to lack of alignment with research questions. Through this systematic filtering process, the review benefits from increased reliability.

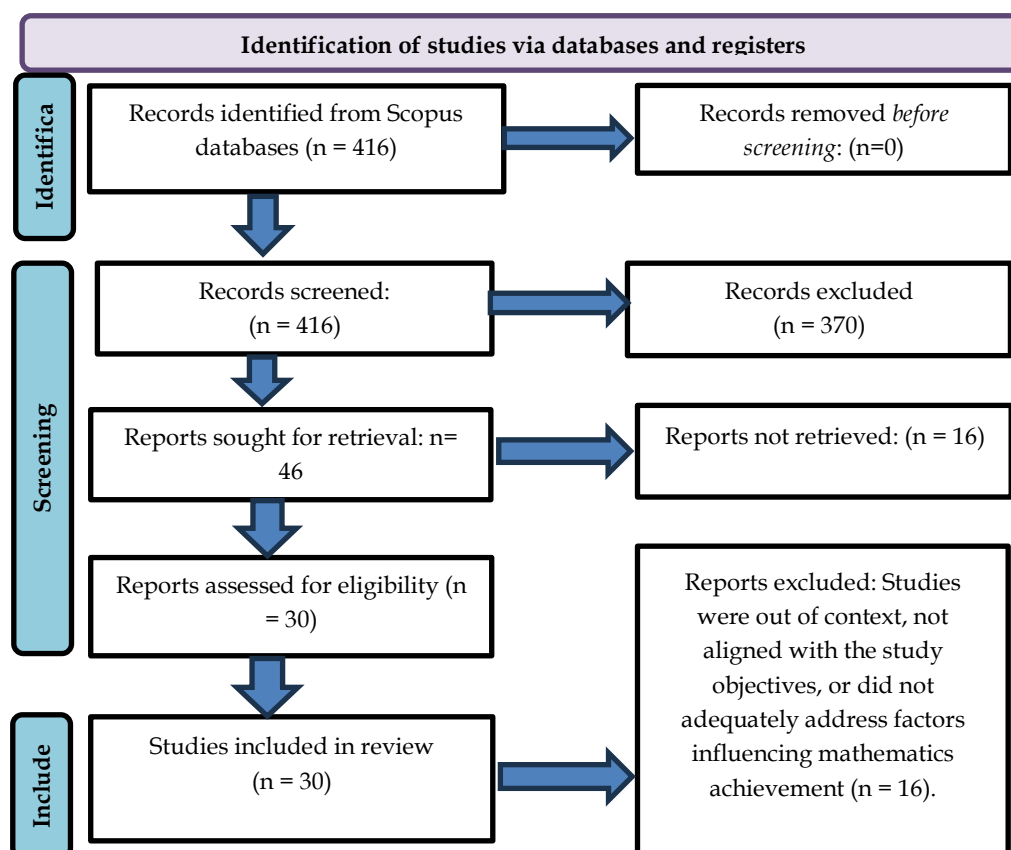


Figure 1: PRISMA flowchart in the inclusion and exclusion process

3.4. Studies Included for Analysis

Table 3 presents 30 studies extracted from the Scopus database between 2015 and 2025 by various authors focusing on mathematics achievement across different contexts. It highlights diverse methodologies (quantitative, longitudinal, multilevel, and experimental approaches) used to examine key influencing factors. These 30 studies have been included for analysis. These studies focus on different factors that are responsible for mathematics achievement. In the 21st century it is very important to know the factors that are related to the lack of mathematics achievement among school students.

Table 3: Studies Included for Analysis

Study ID(s)	Author(s) & Year	Title	Major Findings
S1	(Van Der Beek et al., 2017)	<i>Self-concept mediates the relation between achievement and emotions in mathematics.</i>	Self-concept fully mediates the relationship between achievement in mathematics and emotions; high achievers show higher self-concept and lower anxiety.
S2	(Maamin et al., 2021)	<i>The Influence of Student Engagement on Mathematical Achievement among Secondary School Students</i>	Affective, behavioral, and cognitive engagement significantly predict mathematics achievement; affective engagement is strongest.
S3	(Howard et al., 2023)	<i>Let's Talk: Parental Involvement as a Predictor of STEM Achievement in Math for High School Girls</i>	Parental involvement has significantly predicted math achievement for some ethnic groups.
S4	(Ugwuanyi et al., 2020)	<i>Prediction of learners' mathematics performance by emotional intelligence, self-esteem, and self-efficacy</i>	Emotional intelligence, self-esteem, and self-efficacy significantly predict achievement.
S5	(Bal, 2016)	<i>The Effect of the Differentiated Teaching Approach in the Algebraic Learning Field on Students' Academic Achievements.</i>	Differentiated teaching improves achievement in algebra and enhances cognitive-affective outcomes.
S6	(Moliner et al., 2022)	<i>COVID-19 Restrictions and its influence on students' mathematics achievement in Spain</i>	COVID-19 restrictions negatively impacted mathematics achievement.
S7	(Vandecandelaere et al., 2016)	<i>Time-Varying Treatments in Observational Studies: Marginal Structural Models of the Effects of Early Grade Retention on Math Achievement</i>	Grade retention influences math achievement.
S8	(Kiwanuka et al., 2015)	<i>Factors affecting mathematics of first-year secondary school students' achievement in central Uganda</i>	Achievement is influenced by student, classroom, and school factors; SES and prior achievement are key predictors.
S9	(Morgan et al., 2023)	<i>Racial and Ethnic Disparities in Advanced Science and Mathematics Achievement during Elementary School</i>	SES and early achievement create disparities in advanced math performance.

Study ID(s)	Author(s) & Year	Title	Major Findings
S10	(Sapazhanov et al., 2020)	<i>Factors Affecting Mathematics Achievement in Central Asian Specialized Universities</i>	High school grades and confidence significantly predict achievement.
S11	(Tomul et al., 2021)	<i>The relative effect of student, family, and school-related factors on math achievement by location of the school</i>	Student-related factors, especially confidence, have the strongest effect.
S12	(Su & He, 2020)	<i>Exploring Factors Linked to the Mathematics Achievement of Ethnic Minority Students in China for Sustainable Development: A Multilevel Modeling Analysis. Sustainability,</i>	Self-efficacy, strategies, gender, and teacher satisfaction have influenced achievement in mathematics.
S13	(Moliner et al., 2022)	<i>The COVID-19 Pandemic's Impact on 9th Grade Students' Mathematics Achievement.</i>	The pandemic reduced mathematics achievement due to lack of motivation and environmental changes.
S14	(Bozick et al., 2016)	<i>Premigration School Quality and Time Spent in the United States, and the Math Achievement of Immigrant High School Students</i>	Prior education quality has improved achievement in mathematics.
S15	(Lavelle-Hill et al., 2024)	<i>How the predictors of math achievement change over time: A longitudinal machine learning approach</i>	Prior achievement in mathematics is the strongest predictor, and other factors contribute moderately.
S16	(Gao et al., 2025b)	<i>The impact of online lesson study on students' achievement in mathematics in China</i>	Online lesson study improves teaching practices and student achievement in mathematics.
S17	(Yarkwah et al., 2024)	<i>Effect of test anxiety on students' academic performance in mathematics at the senior high school level</i>	Test anxiety negatively affects mathematics performance; females show higher anxiety.
S18	(Boadu & Boateng, 2024)	<i>Enhancing students' achievement in mathematics education in the 21st century through technology integration, collaborative learning, and student motivation: The mediating role of student interest</i>	Technology and collaboration positively influence math achievement; motivation is less significant.

Study ID(s)	Author(s) & Year	Title	Major Findings
S19	(Joshi et al., 2025)	<i>Effect of using digital resources on mathematics achievement: Results from PISA</i>	Use of digital tools strongly predicts mathematics achievement.
S20	(Teoh Sian Hoon, 2022)	<i>Mathematics Anxiety and its Relationship with Mathematics Achievement Among secondary school students</i>	Strong negative relationship between math anxiety and mathematics achievement.
S21	(Dada & Akpan, 2019)	<i>Discriminant analysis of psycho-social predictors of mathematics achievement of gifted students in Nigeria</i>	Self-efficacy, interest, peer influence, and parental influence predict achievement.
S22	(Asp et al., 2025)	<i>Does teaching quality matter for Nordic primary school students' mathematics confidence and mathematics achievement? A multilevel structural equation analysis of Nordic TIMSS 2019 grade 4 data</i>	Teaching quality significantly improves achievement in mathematics and confidence among students.
S23	(Bohrnstedt et al., 2024)	<i>Mathematics Motivation and Mathematics Performance: Does Gender Play a Role?</i>	Math identity and expectations significantly predict achievement; gender differences exist.
S24	(Mackin Freeman & Shifrer, 2023)	<i>Arts for Whose Sake? Arts Course-taking and Math Achievement in US High</i>	Arts (music) positively relate to achievement, mainly for high-SES students.
S25	(Adewuyi & Gbolade, 2024)	<i>Psychosocial Predictors of Students' Achievement in Mathematics: A Path-Analytical Study</i>	Self-efficacy, motivation, anxiety, and peer influence affect achievement.
S26	(Stelzer et al., 2024)	<i>Mathematics achievement in the last year of primary school. Longitudinal relationship with general cognitive skills and prior mathematics knowledge</i>	Prior knowledge and cognitive skills strongly predict mathematics achievement.
S27	(Anbar et al., 2022)	<i>Math Anxiety, Math Achievement and Gender Differences among Primary School Children and their Parents from Palestine</i>	Math anxiety negatively impacts mathematics achievement; mathematics anxiety is higher among girls.
S28	(Wole et al., 2025)	<i>The role of social goal orientation and academic help-seeking behavior on mathematics achievement of primary students</i>	Social goals and help-seeking positively influence mathematics achievement.

Study ID(s)	Author(s) & Year	Title	Major Findings
S29	(Ndelale et al., 2025)	<i>Family and teacher predictors of mathematics achievement in senior high school students: Evidence from SEM</i>	Teacher factors significantly influence achievement in mathematics; family background has less significance.
S30	(Alharbi & Aldhafiri, 2024)	<i>The Relationship of Mathematical Reasoning to Mathematics Achievement and Academic Excellence</i>	There is a Strong positive relationship between reasoning and mathematics achievement.

4. Results and Findings

This section presents the four research questions and their findings.

RQ 1: What are the key trending factors in mathematics achievement among school students from 2015 to 2025?

Table 4 describes key trending factors that affect mathematics achievement, and it shows that psychological factors have been demonstrated to be the dominant predictive factor of mathematical achievement, with self-efficacy, self-concept, and mathematics anxiety being key sub-factors. Specifically, students' internal attributes greatly affect how they perform in mathematics. Factors related to students are seen to be the next most important category and emphasize student engagement, previous performance, and cognitive abilities. Specifically, affective engagement and foundational knowledge were found to consistently demonstrate positive associations with an increase in mathematics achievement, emphasizing the importance of being ready to learn as well as participating actively in learning experiences.

Family and social-related factors are still present. They have been demonstrated to be negatively impacted by socioeconomic status, parental involvement, and peer influence. Current research shows that learning is influenced not only by structural factors such as socioeconomic status, but also by the quality of academic interactions at home and school, highlighting the complex role of external influences in the learning process. Teaching quality and classroom climate are key factors associated with student success in a school environment. Effective classroom management and clear instruction are critical to mathematics learning, highlighting the important role teachers play in helping learners develop mathematical understanding.

Table 4: Trending factors in mathematics achievement among school students from 2015 to 2025

Trend Factor Category	Sub-Factors	Study IDs	No. of Studies	Research Method	Key Trends
Psychological Factors	Self-concept, self-efficacy, anxiety, motivation, emotional intelligence, self-esteem, interest	S1, S4, S10, S15, S17, S20, S21, S23, S25, S27	10	Quantitative (survey, correlational, SEM)	Strongest predictors: self-efficacy and anxiety significantly influence mathematics achievement. The mediation effects is evident
Student-Related Factors	Engagement, prior achievement, cognitive ability, reasoning, learning strategies, help-seeking	S2, S8, S11, S12, S15, S26, S28, S30	8	Quantitative (survey, longitudinal)	Engagement and prior knowledge are key predictors. Cognitive abilities are gaining importance
Family Factors	Parental involvement, SES, parental education, home environment, parental anxiety	S3, S8, S9, S11, S14, S27, S29	7	Quantitative (survey, secondary data)	SES and parental involvement remain strong, with interaction quality emerging
Social Factors	Peer influence, gender, ethnicity, social goals, collaboration	S8, S9, S21, S23, S27, S28	6	Quantitative (correlational, SEM)	Peer influence and gender disparities persist, and the equity issues highlighted
School-Related Factors	Teaching quality, classroom climate, school location, classroom management	S8, S11, S12, S22, S29	5	Quantitative (multilevel analysis)	Teaching quality and classroom environment significantly impact mathematics achievement

Trend Factor Category	Sub-Factors	Study IDs	No. of Studies	Research Method	Key Trends
Instructional Practices	Differentiated instruction, teaching strategies, lesson study, pedagogy	S5, S16, S22	3	Mixed Methods (experimental, quasi-experimental)	Learner-cantered and differentiated teaching improves achievement in mathematics
Technology Integration	Digital tools, ICT, online learning, blended learning	S16, S18, S19	3	Quantitative (SEM, secondary data)	Post-2020 growth: Digital tools positively influence mathematics achievement
Recent Developments	COVID-19 impact, machine learning, online education, pandemic effects	S6, S13, S15, S16, S19	5	Mixed Methods (experimental, predictive)	COVID caused learning loss in mathematics, and AI/ML and online learning are emerging trends

Instructional methods and technology integration are still emerging as an area in research, and there continue to be promising impacts on mathematics achievement. For example, learner-centered instructional approaches and differentiated instruction have a positive impact on students' overall achievement while the increased use of technology and, particularly after the onset of the COVID-19 pandemic, the usage of digital technologies have prompted a shift toward technology-enhanced learning environments. The recent advances being made within educational research—a result of the pandemic and machine learning approaches.

It shows both disruptions to students' learning experiences and advancements in predictive educational research. The maximum studies related to mathematics achievement have been using quantitative methods, with the majority using survey and correlational methods with SEM, and the use of mixed-method research designs is becoming more common. However, there is still a lack of experimental design-based research studies, demonstrating a significant gap in intervention-based research. Different psychological, cognitive, social, and institutional factors are influencing students' mathematics performance.

RQ 2: How do psychological and student-related factors influence students' mathematics achievement?

Table 5 depicts how students' mathematics achievement is determined by two types of factors, i.e. psychological and student-related which have an impact on a student's learning output and interact with each other to shape learning outcomes in mathematics. Psychological factors provide students with a foundation for how they perceive themselves and how they affect their attitudes toward mathematics.

Factors such as self-concept, emotional intelligence, self-efficacy, and motivation develop a student's willingness to participate in mathematics and to engage in classroom activities. As a result, it will increase a student's level of achievement in mathematics. Conversely, the presence of mathematics anxiety negatively impacts the mathematics achievement of low-achieving students through strong emotional barriers to learning.

In addition to the above psychological factors, several psychosocial factors, e.g., peer pressure and self-perception, can support or hinder students' learning outcomes. Factors related to students refer to how students are engaging during their learning process. Affective engagement of students, or emotional connection with their learning, is a medium to strong predictor of student performance, as those who have an emotional connection are typically more successful than those who do not.

Table 5: Psychological and student-related factors influence students' mathematics achievement

Factor Type	Sub-factors	Study ID	Key Findings
Psychological Factors	Self-Concept	S1	Mathematical self-concept mediates the relationship between mathematics achievement and emotions; higher self-concept improves mathematics performance
	Emotional Factors (EI, self-esteem, Self-efficacy)	S4	Emotional intelligence, self-esteem, and self-efficacy significantly predict mathematics achievement
	Mathematics Anxiety	S17	Mathematics anxiety negatively affects academic performance in mathematics
	Mathematics Anxiety	S20	There is a strong inverse relationship between anxiety and mathematics performance, especially among low achievers
	Motivation & Identity	S23	Motivation, identity, and expectations significantly predict mathematics achievement
	Psychosocial Factors	S25	Self-efficacy, motivation, and peer influence significantly contribute to Mathematics achievement
Student-Related Factors	Student Engagement	S2	Affective, behavioral, and cognitive engagement significantly influence achievement in mathematics. The affective engagement is the strongest predictor
	Cognitive Ability	S26	Prior knowledge, working memory, and cognitive abilities influence mathematics achievement
	Learning Behavior	S28	Social goal orientation and academic help-seeking behavior positively affect mathematics achievement

Factor Type	Sub-factors	Study ID	Key Findings
	Higher-Order Skills	S30	Mathematical reasoning positively correlates with mathematics achievement

Similarly, a student's cognitive capability e.g., previous experience or knowledge and working memory, directly contributes to the student's level of understanding and ability to solve problems in the classroom. In addition, a student's behaviors while in the classroom relates to their learning and successful use of effective learning strategies e.g. seeking help, having goals and use of higher-order skills i.e., mathematical reasoning, are strongly associated with high levels of success. Mathematics achievement is a result of the combination of the student's psychological characteristics and student factors whether or not students are actively engaged in their own learning. In general, both psychological and cognitive components are equally important for fostering the success of students in mathematics.

RQ 3: How do family, social, and school-related factors affect students' mathematics achievement?

Table 6 explains the combination of factors from the family, social and school environments that impact achievement in mathematics among students. Family factors influence mathematics achievement based upon the level of parental involvement, parental background, level of support from the family and socioeconomic status of the family members. Active support from a parent or guardian greatly assists in achieving a good grade while the provision of the socioeconomic status of the family assists students to be able to participate in a much better learning environment. The level of anxiety experienced by a parent and home environment in which the child lives play an extremely important role in the child's ability to perform in math and their attitude toward math.

Table 6: Family, social, and school-related factors affect students' mathematics achievement

Factors	Sub-factors	Study ID	Key Findings
Family Factors	Parental Involvement	S3	Parental involvement significantly predicts students' mathematics achievement
	Family Background	S27	Parental anxiety and involvement influence students' performance and mathematics anxiety
	Socioeconomic Status (SES)	S8	SES and parental support significantly influence students' mathematics achievement
Social Factors	Peer Influence	S21	Peer and parental influence significantly determine students' mathematics achievement
	Educational Inequality	S9	Socioeconomic and early academic factors explain disparities in mathematics achievement
School-Related Factors	School Context	S11	School environment and contextual variables significantly

Factors	Sub-factors	Study ID	Key Findings
			influence mathematics achievement
	Learning Environment	S12	Learning strategies and classroom environment significantly predict mathematics achievement
	Teacher Factors	S29	Teacher-related factors significantly impact mathematics achievement more than family background

The social factors highlighted in the table show that peers and the impact of larger systemic educational inequities can strongly influence how well a student performs in mathematics. Positive peer-to-peer interaction can help increase student success, while students performing at levels commensurate with their peers may be impacted by their socioeconomic status and the type of early education they received prior to entering school. School-related factors also have an important impact on mathematics achievement in terms of the school climate or environment, learning conditions or instructional practices, and teacher effectiveness. Among these factors, teacher-related factors appear to have the greatest impact on the student's academic success; in many cases exceeding that of the student's family background. The data in the table show that mathematics achievement is strongly influenced by external factors, with support from families, peers, and schools helping to create environments that promote success in mathematics.

RQ 4: How are instructional practices, technology integration, and recent developments affecting the students' mathematics achievement after COVID-19? Table 7 indicates that instructional practices, technology integration, and recent development affect the level of achievement by students in mathematics. The role of instructional practices in enhancing children's mathematics performance is essential. The teaching strategies used to foster achievement in mathematics include differentiated instruction based on individual learners' needs. Clear instructions and high-quality classroom management help students understand mathematics.

The professional growth or development of teachers contributes to greater improvement in student success. The integration of technology has been found to greatly enhance the level of students' engagement and comprehension, therefore increasing their level of achievement. The integration of technology in the classroom can also help students have a greater understanding of mathematical concepts when used effectively. Mathematics achievement has suffered because of recent events (e.g., the coronavirus pandemic).

Table 7: Instructional practices, technology integration, and recent developments affecting the students' mathematics achievement after COVID-19

Factors	Sub-factors	Study ID	Key Findings
Instructional Practices	Differentiated Instruction	S5	Differentiated teaching improves students' academic achievement and supports diverse learners
	Teaching Quality	S22	Instructional clarity and classroom management strongly influence mathematics achievement
	Teacher Professional Development	S16	Online lesson study enhances teaching practices and improves student performance in mathematics
Technology Integration	Digital Learning Resources	S19	Use of digital resources significantly predicts mathematics achievement
	Collaborative Learning & Technology	S18	Technology integration and collaborative learning positively influence mathematics achievement
Recent Developments	COVID-19 Impact	S6	COVID-19 restrictions caused a decline in students' mathematics achievement
		S13	Pandemic disruptions negatively affected performance, motivation, and engagement in mathematics
	Longitudinal Learning Trends	S15	Prior achievement in mathematics is the strongest predictor for mathematics achievement

The disruption of the traditional educational system has led to reductions in student engagement and motivation as well as in their ability to interact with teachers and peers in a real classroom. However, data suggests that prior performance in mathematics continues to be an excellent predictor of future achievement in mathematics. This prediction includes the contribution of instructional and environmental influences over time. The data presented in Table 7 provides significant evidence that effective instructional methods and meaningful integration of technology can improve student mathematics achievement. In contrast, external disruptions such as COVID-19 (the pandemic) can create challenges for students to successfully engage in the learning process. This research supports the importance of developing adaptive and resilient strategies for education that will address current and future educational disruptions.

5. Discussion

The present systematic review study synthesizes the evidence on the factors influencing students' mathematics achievement during the period 2015–2025. The findings are discussed under three major categories: psychological and student-related factors; family, social, school-related factors, and instructional practices, technology, and recent developments.

The analysis revealed that the factors that most significantly impact students' performances in mathematics are psychological and student-related factors. The most common variables positively affecting students' performances are self-concept, emotional intelligence, social intelligence, self-efficacy, and motivation. Through self-concept, students will be able to perform better, display confidence, and become more engaged in their learning process of mathematics (Van Der Beek et al., 2017). In addition, emotional competencies produce the same result as "self-concept" (Ugwuanyi et al., 2020). Mathematics anxiety is always represented as a negative predictor of achievement in mathematics. When students experience high levels of anxiety, they are less likely to be successful and process the mathematical information necessary to achieve success, resulting, in part, in low-performing students (Anbar et al., 2022; Yarkwah et al., 2024). To improve student outcomes in mathematics, all barriers have been addressed.

First, student-related factors emphasize the importance of actively engaging in learning both emotionally as well as having the necessary cognitive skills to do this, and these two factors together contribute to improving learning outcomes. Engagement, especially affective engagement, positively influences learning by creating interest in and participation with the learning material (Anbar et al., 2022; Yarkwah et al., 2024) while cognitive-related factors (e.g., working memory or previous knowledge) facilitate successful completion of a problem and a comprehensive understanding of a concept (Stelzer et al., 2024).

Another group of behavior-related variables includes help-seeking behaviors and goal orientation, which can support students in using effective strategies for success in their learning while higher-level cognitive thinking (e.g., mathematics reasoning) relates to increasing the success of students (Alharbi & Aldhafiri, 2024; Wole et al., 2025). Taken together, these results indicate that mathematics achievement is determined by the relationship between individual cognitive attributes and emotional attributes of students and their active engagement within the learning process.

The review also presents evidence that many contextual factors, such as family, society, and school environments, can profoundly affect how well students do in mathematics. Among family-related variables, one of the strongest predictors for being successful academically is the level of involvement that parents have with their child's education. Parental involvement is based on communication and participation in activities related to learning. It has a strong influence on how much their child will achieve academically (Howard et al., 2023). In addition, socioeconomic status (SES) affects students' access to educational resources and opportunities, which results in students having different levels of performance (Morgan et al., 2023).

Similarly, social factors, including peer influences, have a significant impact on students' academic outcomes. Positive interaction with peers promotes the learning process through cooperation improve understanding of mathematical concepts while the economic and early academic background of a student have an effect on how they will perform compared to other students with similar

backgrounds (Sapazhanov et al., 2020). The results of this study demonstrate the continuing disparity of mathematics performance across different demographic populations. There are many components involved when determining student achievement. Within a school, the factors determining student achievement are the school climate, learning environment, and variables associated with teachers. Classroom climate is important as it provides students with effective strategies that they may be able to use. Studies have found that teachers may be a larger contributing factor to students' mathematics achievement than family, social influences (Asp et al., 2025). In terms of mathematics, research has found that student achievement is influenced by individual characteristics as well as institutional and social variables.

Key contributors to the success of mathematics achievement have been identified as a combination of (1) innovative instructional approaches and (2) the advancement and integration of technology in education. According to (Bal, 2016), differentiated instruction is one of the most effective ways that teachers can address the varied needs of their students while also enhancing student achievement in mathematics. Effective instructional practices, for example, quality teaching, directed teaching and learning, and good management of the classroom, support students' understanding of mathematics concepts and the ability to complete mathematics tasks successfully (Asp et al., 2025).

In addition, the importance of the professional development of teachers is crucial to the development of quality instructional practices. Using innovative methods such as online classes to provide teachers opportunities to improve their teaching has resulted in improvements in instruction and outcomes for students (Gao et al., 2025a). Technology integration is an essential part of successful teaching and learning. Digital resources can greatly increase student interest and success through the use of technology in collaborative learning (Boadu & Boateng, 2024; Joshi et al., 2025). When technology has been integrated appropriately into instructional practices, technology can lead to potential improvements and change the way mathematics is taught and learned. Mathematics achievement has also been adversely affected by new occurrences like the COVID-19 pandemic.

As educational settings were disrupted, student motivation, interaction with peers, and engagement in learning are diminished; as a consequence, there is a reduction in student learning (Moliner et al., 2022; Moliner & Alegre, 2022). In spite of the difficulties that are presented by the above-mentioned findings, longitudinal research continues to show prior levels of student achievement to be the best predictor of subsequent student achievement. Additionally, both instructional and contextual factors accrue over a period of time (Lavelle-Hill et al., 2024). On the whole, these findings support the idea of using adaptive instructional methods and technology as a means of improving mathematics achievement in times of interruptions in education.

6. Educational Implications

The novelty of this study lies in identifying the factors of mathematics achievement. This review highlights how holistic, evidence-based approaches to

mathematics may improve the mathematics achievement of students. Teachers can develop student psychological traits such as positive self-concept, reduce mathematics anxiety, and increase motivation and self-efficacy through engaging and supportive learning experiences in their classrooms. Teachers should promote active learner engagement, develop higher-order thinking and problem-solving skills, encourage help-seeking behaviour, manage classrooms effectively, and participate in ongoing professional development. Schools should develop suitable learning environments through providing quality teaching, enabling effective classroom management, and providing teachers with ongoing professional development.

Policymakers and educators should promote active, meaningful parental involvement and eliminate socioeconomic inequities so that every student has access to equitable learning opportunities. Integration of technology and digital resources should be intentional to improve students' achievement, especially through methods of collaboration and interaction. The continuing disruption to education due to COVID-19, there is a necessity to create a more resilient learning environment through flexible instructional practices e.g., blended learning to enable ongoing education for students. In summary, improving a student's mathematical performance requires the application of a holistic approach integrating psychological support, quality pedagogy, technology innovation and inclusive policy.

7. Scope for Further Research

This systematic review presents several important directions for future research pertaining to students' mathematics achievement. Longitudinal studies are suggested in order to track how different factors, such as self-concept, motivation, and mathematics anxiety, affect students' achievements over time and across different levels of schooling. Future studies should also investigate the interaction between family, social, and school-related factors in order to develop a comprehensive understanding of how these variables all interact together to produce results related to mathematics achievement. As the use of technology in education is growing, more studies need to examine how well technology works when integrated into lessons and what types of digital strategies would be effective in mathematics.

In addition, there is a need for further research related to the longer-term effects of post-COVID-19 disruption of learning and how this will be resolved in terms of learning recovery and whether hybrid models will effectively teach students mathematics. There is a lack of information regarding equity and inclusion; an examination of how students' socioeconomic status, gender, and geographic regions contribute to their level of mathematics achievement should be a priority for future research. Finally, there should be an emphasis on innovative pedagogies such as multisensory and exploratory-based instructional methods through the use of mixed-method research designs, interdisciplinary approaches, and creating thorough and relevant knowledge for policymakers. The results of this study indicate the need for future studies to employ more experimental,

intervention-oriented designs, particularly in the areas of multisensory instruction and instructional practices that integrate technology.

8. Conclusion

This systematic literature study was conducted to examine trends and factors affecting students' mathematics achievement over the period 2015–2025. The results indicate that many different psychological, student-related, family-related, social, school-based and instructional factors have influenced mathematics achievement. But they are all likely to be significantly interconnected. For example, psychological attributes such as self-concept, motivation, and self-efficacy will have a positive influence on achievement in mathematics; whereas mathematics anxiety will negatively impact student performance. Student-related factors such as engagement, cognitive ability and higher-order thinking will influence how well a student acquires mathematical knowledge.

In addition, external contextual factors such as parental involvement, socioeconomic status, peer influence and the school environment have a strong influence on students' mathematics achievement. Teacher's teaching effectiveness and effective classroom practices will be the two most important influences on students' success. The systematic review shows that there has been an increasing focus on instructional strategies and technology integration as strategies to improve mathematics achievement, especially during the COVID-19 pandemic time when the educational process has been disrupted.

Overall, the study indicates that there is a need for a holistic and integrated approach to mathematics education that considers both the internal characteristics of the learner and the external contextual factors affecting the learner. By providing a supportive learning environment, continuing to improve the quality of teaching, and using technology, all educational stakeholders can improve students' mathematics achievement and achieve equitable and sustainable educational development.

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Conflict of Interests

The authors declare that there is no conflict of interest.

10. References

- Adewuyi, H. O., & Gbolade, O. O. A. (2024). Psychosocial predictors of students' achievement in mathematics: A path-analytical study. *International Journal of Learning, Teaching and Educational Research*, 23(6), 171-188. <https://doi.org/10.26803/ijlter.23.6.8>
- Alharbi, H., & Aldhafiri, S. (2024). The relationship of mathematical reasoning to mathematics achievement and academic excellence. *Journal of Education and Training Studies*, 12(4), 79-91. <https://doi.org/10.11114/jets.v12i4.7185>
- Anbar, N., Cheie, L., & Visu-Petra, L. (2022). Math anxiety, math achievement and gender differences among primary school children and their parents from Palestine. *International Journal of Learning, Teaching and Educational Research*, 21(8), 326-334. <https://doi.org/10.26803/ijlter.21.8.19>
- Asp, L., Klapp, A., & Rosén, M. (2025). Does teaching quality matter for Nordic primary school students' mathematics confidence and mathematics achievement? A multilevel structural equation analysis of Nordic TIMSS 2019 grade 4 data. *Large-Scale Assessments in Education*, 13(1), 1-31. <https://doi.org/10.1186/s40536-025-00238-x>
- Bal, A. P. (2016). The effect of the differentiated teaching approach in the algebraic learning field on students' academic achievements. *Eurasian Journal of Educational Research*, 16(63), 185-204. <https://doi.org/10.14689/ejer.2016.63.11>
- Boadu, S. K., & Boateng, F. O. (2024). Enhancing students' achievement in mathematics education in the 21st century through technology integration, collaborative learning, and student motivation: The mediating role of student interest. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(11), 1-17, em2534. <https://doi.org/10.29333/ejmste/15622>
- Bohrnstedt, G. W., Zhang, J., Li, M., Ikoma, S., Park, B. J., & Broer, M. (2024). Mathematics motivation and mathematics performance: Does gender play a role? *AERA Open*, 10(1), 1-17. <https://doi.org/10.1177/23328584241298272>
- Bozick, R., Malchiodi, A., & Miller, T. (2016). Premigration school quality, time spent in the United States, and the math achievement of immigrant high school students. *Demography*, 53(5), 1477-1498. <https://doi.org/10.1007/s13524-016-0497-3>
- Chien, P., & Khan, K. (2023). Systematic review reporting – Writing concisely and precisely. *Pakistan Journal of Medical Sciences*, 39(2), 317-322. <https://doi.org/10.12669/pjms.39.2.7428>
- Dada, O., & Akpan, S. M. (2019). Discriminant analysis of psycho-social predictors of mathematics achievement of gifted students in Nigeria. *Journal for the Education of Gifted Young Scientists*, 7(3), 581-594. <https://doi.org/10.17478/jegys.605981>
- Fong, C. J., & Kremer, K. P. (2020). An expectancy-value approach to math underachievement: examining high school achievement, college attendance, and STEM interest. *Gifted Child Quarterly*, 64(2), 67-84. <https://doi.org/10.1177/0016986219890599>
- Gao, H., Li, J., Kwan Eu, L., Yun, T., & Wang, C. (2025). The impact of online lesson study on students' achievement in mathematics in China. *Educational Action Research*, 33(2), 378-394. <https://doi.org/10.1080/09650792.2024.2325665>
- Howard, N. R., Howard, K. E., Busse, R. T., & Hunt, C. (2023). Let's talk: An examination of parental involvement as a predictor of STEM achievement in math for high school girls. *Urban Education*, 58(4), 586-613. <https://doi.org/10.1177/0042085919877933>
- Joshi, D. R., Sharma Chapai, K. P., Upadhayaya, P. R., Adhikari, K. P., & Belbase, S. (2025). Effect of using digital resources on mathematics achievement: Results from PISA 2022. *Cogent Education*, 2488161 12(1), 1-22. <https://doi.org/10.1080/2331186X.2025.2488161>

- Kitsantas, A., Cheema, J., & Ware, H. W. (2011). Mathematics achievement: The role of homework and self-efficacy beliefs. *Journal of Advanced Academics*, 22(2), 310–339. <https://doi.org/10.1177/1932202X1102200206>
- Lavelle-Hill, R., Frenzel, A. C., Goetz, T., Lichtenfeld, S., Marsh, H. W., Pekrun, R., Sakaki, M., Smith, G., & Murayama, K. (2024). How the predictors of math achievement change over time: A longitudinal machine learning approach. *Journal of Educational Psychology*, 116(8), 1383–1403. <https://doi.org/10.1037/edu0000863>
- Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P. A., Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: Explanation and elaboration. *BMJ*, 339(jul21 1), b2700–b2700. <https://doi.org/10.1136/bmj.b2700>
- Liu, R., Jong, C., & Fan, M. (2024). Reciprocal relationship between self-efficacy and achievement in mathematics among high school students: First author. *Large-Scale Assessments in Education*, 14, 12(1), 1–16. <https://doi.org/10.1186/s40536-024-00201-2>
- Lv, B., Lv, L., Wang, P., & Luo, L. (2019). A person-centered investigation of math motivation and its correlates to math achievement in elementary students. *Journal of Pacific Rim Psychology*, 13, 1–7. <https://doi.org/10.1017/prp.2019.21>
- Maamin, M., Maat, S. M., & H. Iksan, Z. (2021). The Influence of Student Engagement on Mathematical Achievement among Secondary School Students. *Mathematics*, 10(1), 1–14. <https://doi.org/10.3390/math10010041>
- Mackin Freeman, D., & Shifrer, D. (2023). Arts for whose sake? Arts course-taking and math achievement in US high schools. *Sociological Perspectives*, 66(2), 226–245. <https://doi.org/10.1177/07311214221124537>
- Meyer, J., Fleckenstein, J., & Köller, O. (2019). Expectancy value interactions and academic achievement: Differential relationships with achievement measures. *Contemporary Educational Psychology*, 58, 58–74. <https://doi.org/10.1016/j.cedpsych.2019.01.006>
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & The PRISMA Group. (2009). Preferred Reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS Medicine*, 6(7), e1000097–e1000097. <https://doi.org/10.1371/journal.pmed.1000097>
- Moliner, L., & Alegre, F. (2022). COVID-19 Restrictions and its influence on students' mathematics achievement in Spain. *Education Sciences*, 105 12(2), 1–10. <https://doi.org/10.3390/educsci12020105>
- Moliner, L., Alegre, F., & Lorenzo-Valentin, G. (2022). The COVID-19 pandemic's impact on 9th grade students' mathematics achievement. *European Journal of Educational Research*, 11(2), 835–845. <https://doi.org/10.12973/eu-jer.11.2.835>
- Morgan, P. L., Hu, E. H., Farkas, G., Hillemeier, M. M., Oh, Y., & Gloski, C. A. (2023). Racial and ethnic disparities in advanced science and mathematics achievement during elementary school. *Gifted Child Quarterly*, 67(2), 151–172. <https://doi.org/10.1177/00169862221128299>
- Ndelale, I., Gordon, J. F., Appiagyei, E., & Akendita, P. A. (2025). Family and teacher predictors of mathematics achievement in senior high school students: Evidence from SEM. *Journal of Pedagogical Sociology and Psychology*, 7(4), 1–12. <https://doi.org/10.33902/JPSP.202533190>
- Skaalvik, E. M., Federici, R. A., & Klassen, R. M. (2015). Mathematics achievement and self-efficacy: Relations with motivation for mathematics. *International Journal of Educational Research*, 72, 129–136. <https://doi.org/10.1016/j.ijer.2015.06.008>
- Sapazhanov, Y., Orynassar, A., Kadyrov, S., & Sydykhov, B. (2020). factors affecting mathematics achievement in Central Asian specialized universities. *International Journal of Emerging Technologies in Learning (iJET)*, 15(19), 143–153. <https://doi.org/10.3991/ijet.v15i19.15629>

- Stelzer, F., Vernucci, S., Aydmune, Y., Del Valle, M., Andres, M. L., & Introzzi, I. M. (2024). Mathematics achievement in the last year of primary school. Longitudinal relationship with general cognitive skills and prior mathematics knowledge. *European Journal of Psychology of Education*, 39(2), 517–533. <https://doi.org/10.1007/s10212-023-00700-w>
- Su, A., & He, W. (2020). Exploring Factors linked to the mathematics achievement of ethnic minority students in China for sustainable development: A multilevel modeling analysis. *Sustainability*, 12(7), 1-14. <https://doi.org/10.3390/su12072755>
- Teoh Sian Hoon, S. H. O. (2022). Mathematics Anxiety and its Relationship with Mathematics Achievement Among Secondary School Students. *Asian Journal of University Education*, 18(4), 863–878. <https://doi.org/10.24191/ajue.v18i4.19992>
- Tomul, E., Önder, E., & Taslidere, E. (2021). The relative effect of student, family and school-related factors on math achievement by location of the school. *Large-Scale Assessments in Education*, 9(1), 1-29. <https://doi.org/10.1186/s40536-021-00117-1>
- Ugwuanyi, C. S., Okeke, C. I. O., & Asomugha, C. G. (2020). Prediction of learners' mathematics performance by their emotional intelligence, self-esteem and self-efficacy. *Cypriot Journal of Educational Sciences*, 15(3), 492–501. <https://doi.org/10.18844/cjes.v15i3.4916>
- Van Der Beek, J. P. J., Van Der Ven, S. H. G., Kroesbergen, E. H., & Leseman, P. P. M. (2017). Self-concept mediates the relation between achievement and emotions in mathematics. *British Journal of Educational Psychology*, 87(3), 478–495. <https://doi.org/10.1111/bjep.12160>
- Vandecandelaere, M., Vansteelandt, S., De Fraine, B., & Van Damme, J. (2016). Time-varying treatments in observational studies: Marginal structural models of the effects of early grade retention on math achievement. *Multivariate Behavioral Research*, 51(6), 1–22. <https://doi.org/10.1080/00273171.2016.1155146>
- Wang, C., Cho, H. J., Wiles, B., Moss, J. D., Bonem, E. M., Li, Q., Lu, Y., & Levesque-Bristol, C. (2022). Competence and autonomous motivation as motivational predictors of college students' mathematics achievement: From the perspective of self-determination theory. *International Journal of STEM Education*, 41, 9(1), 1-14. <https://doi.org/10.1186/s40594-022-00359-7>
- Wole, F. T., Negasi, R. D., & Abebe, A. S. (2025). The role of social goal orientation and academic help-seeking behavior on mathematics achievement of primary students. *Cogent Education*, 12(1), 1-15. <https://doi.org/10.1080/2331186X.2025.2490446>
- Yang, Y., Maeda, Y., & Gentry, M. (2024). The relationship between mathematics self-efficacy and mathematics achievement: Multilevel analysis with NAEP 2019. *Large-Scale Assessments in Education*, 16, 12(1), 1-29. <https://doi.org/10.1186/s40536-024-00204-z>
- Yarkwah, C., Kpotosu, C. K., & Gbormittah, D. (2024). Effect of test anxiety on students' academic performance in mathematics at the senior high school level. *Discover Education*, 3(1), 1-29 245.