Indonesian Journal of Multidiciplinary Research

Journal homepage: http://ejournal.upi.edu/index.php/ IJOMR/

# Students' Confidence in Mathematics: A Comprehensive Literature Review

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## ABSTRACT

Confidence in mathematics significantly influences learners' academic outcomes, motivation, and career aspirations, particularly in STEM-related fields. This literature review explores the interplay between intrinsic and extrinsic factors affecting students' confidence in mathematics. The purpose is to examine how self-efficacy, motivation, anxiety, peer influence, teacher support, and family involvement shape students' beliefs about their mathematical competence. The method involves reviewing international and local empirical studies and theoretical frameworks, including Social Cognitive Theory and Self-Determination Theory. Results show that high self-efficacy and strong social support systems enhance students' confidence, while math anxiety and negative stereotypes diminish it. Because these psychological and contextual elements collectively determine students' academic behavior and resilience, the findings highlight the need for targeted interventions. This review contributes to the growing discourse on educational equity and mathematics achievement by providing a holistic understanding of confidence formation, offering implications for future pedagogical strategies, curriculum design, and school-based support systems.



## ARTICLE INFO

***Article History:***
*Submitted/Received 25 Nov 2024*
*First Revised 29 Dec 2024*
*Accepted 25 Feb 2025*
*First Available online 26 Feb 2025*
*Publication Date 01 Mar 2025*

***Keyword:***
*Academic motivation,*
*Mathematics achievement,*
*Peer support,*
*Self-efficacy,*
*Student confidence.*

## 1. INTRODUCTION

Confidence in mathematics has increasingly become a focal point in educational research, particularly as global assessments reveal persistent underperformance and disengagement in the subject. Students' lack of confidence in their mathematical abilities continues to hinder their academic success and interest in mathematics-related careers. This issue is especially urgent in light of the growing demand for competencies in Science, Technology, Engineering, and Mathematics (STEM) fields, where mathematics serves as a foundational skill (Yıldız & Akdal, 2019; Shaughnessy, 2013).

Mathematical confidence refers to a learner's belief in their capability to understand and perform mathematical tasks. It is closely tied to performance outcomes, with students who possess high confidence demonstrating better problem-solving skills, persistence, and academic achievement (Mohamadi *et al*., 2011; Beesley *et al*., 2018). Despite this, many students exhibit low self-confidence in mathematics due to anxiety, negative past experiences, and societal stereotypes (Jameson & Ridley, 2020; Else-Quest *et al*., 2019). These challenges impact not only their performance but also their long-term motivation and willingness to engage with mathematics (Ramirez *et al.*, 2018).

Recent research has explored various factors that influence mathematical confidence, including intrinsic factors such as self-efficacy, motivation, and self-concept, as well as extrinsic elements such as classroom environment, teacher support, peer interaction, and parental involvement (Pajares & Miller, 1994; Carreon & De Guzman, 2019; Smith, 2024; Chen & Patel, 2024). However, existing studies often isolate these factors without adequately examining how they interact or how they may collectively contribute to confidence development. Current literature reviews also tend to focus on either psychological or pedagogical perspectives, leaving a gap in integrative analysis (Ismail & Awang, 2010; Hannula *et al*., 2004).

This paper aims to synthesize existing literature to offer a comprehensive understanding of the factors affecting students' confidence in mathematics. It draws from both local and international studies, using self-efficacy theory and social cognitive theory as foundational frameworks (Mohamadi *et al*., 2011; Zimmerman, 2000). The novelty of this review lies in its dual focus on both internal and external contributors to mathematical confidence and their interconnectedness. Because confidence in mathematics is not only a predictor of academic success but also a determinant of future educational and occupational pathways, understanding its development is essential (Watt *et al*., 2024; Anderson & Lopez, 2024).

The purpose of this paper is to analyze the scope and direction of current research on mathematical confidence, identify gaps in the literature, and suggest areas for further exploration. Its novelty lies in the integrative approach to intrinsic and extrinsic factors influencing students' beliefs. The impact of this review is to inform educators, researchers, and policymakers of effective strategies for enhancing student confidence in mathematics and promoting positive educational outcomes (Gumal, 2016; Stylianides & Stylianides, 2014).

## 2. METHODS

This literature review employed a systematic approach to identify, evaluate, and synthesize existing research on students' confidence in mathematics. Peer-reviewed journal articles, books, and credible reports published between 1997 and 2024 were examined to provide a comprehensive understanding of the intrinsic and extrinsic factors influencing mathematical confidence. The search was conducted using academic databases such as Google Scholar, JSTOR, ScienceDirect, and ERIC, employing key terms including "mathematics

DOI: https://doi.org/10.17509/ijomr.v5i1.82065
p- ISSN 2776-608X e- ISSN 2776-5970

confidence," "self-efficacy," "intrinsic motivation," "extrinsic motivation," "math anxiety," and "academic performance."

Inclusion criteria were based on relevance to the topic, empirical evidence, and focus on basic and secondary education contexts. Studies that concentrated on self-efficacy, motivation, parental involvement, peer influence, instructional methods, and cultural or gender disparities in mathematics confidence were prioritized. Articles unrelated to educational settings or lacking empirical data were excluded. The literature was categorized and analyzed thematically to explore prevailing trends, theoretical frameworks, and research gaps. This methodological rigor ensured that the review offers a coherent synthesis of knowledge to inform future educational interventions and studies.

## 3. RESULTS AND DISCUSSION

### 3.1. Conceptualizing Students' Confidence in Mathematics

Students' confidence in mathematics refers to their self-perceived ability to understand, engage with, and succeed in mathematical tasks. This confidence plays a critical role in shaping learners' attitudes, behaviors, and academic outcomes in mathematics. According to Bandura's self-efficacy theory, confidence is a key psychological driver that influences how much effort a student will invest in a task, how persistent they will be in the face of difficulties, and how resilient they are after failure (Mohamadi *et al*., 2011). When students believe they can succeed, they are more likely to adopt positive learning strategies and persist in problem-solving.

Several studies emphasize the importance of this confidence in academic contexts. Richardson and Suinn (2018) highlighted that higher levels of mathematical confidence correlate with greater academic perseverance and achievement. In the Philippine context, Bautista *et al*. (2019) found that students who demonstrated confidence in their mathematical ability performed significantly better than their less confident peers. Moreover, confidence not only affects performance but also influences long-term academic choices, such as enrolling in advanced mathematics courses or pursuing STEM-related careers.

The development of mathematical confidence is complex and influenced by multiple factors, including personal experiences, instructional methods, feedback from teachers and peers, and individual personality traits. It is often shaped early in a student's academic journey and evolves through continuous exposure to mathematical challenges and reinforcement. Confidence is also dynamic; it can improve or decline based on academic success, social interactions, and environmental support. Understanding how students conceptualize and internalize confidence in mathematics is essential to designing interventions that improve engagement, reduce anxiety, and enhance academic performance in this critical subject area (Beesley *et al*., 2018; Hannula *et al*., 2004).

### 3.2. Intrinsic and Extrinsic Influences on Mathematical Confidence

Students' confidence in mathematics is shaped by both intrinsic and extrinsic factors, each playing a unique role in their academic development. Intrinsic factors refer to internal motivators such as self-efficacy, interest, goal orientation, and prior success. These elements influence how students perceive their abilities and approach mathematical challenges. According to Beesley *et al*. (2018), students with high intrinsic motivation are more likely to exhibit persistence, deep engagement, and higher levels of confidence in solving mathematical problems. Furthermore, when students perceive mathematics as meaningful and aligned with their personal goals, they tend to approach it with greater enthusiasm and resilience (Watt *et al*., 2024).

DOI: https://doi.org/10.17509/ijomr.v5i1.82065
p- ISSN 2776-608X e- ISSN 2776-5970

Extrinsic factors include environmental and social influences such as teacher support, parental involvement, peer interactions, and classroom structure. These external elements can either enhance or hinder a student's belief in their mathematical capabilities. For example, positive feedback, encouragement, and clear instructional guidance from teachers foster a supportive learning environment that bolsters students' self-confidence (Ryan & Deci, 2020). Peer collaboration and constructive social dynamics also contribute to a positive classroom culture where students feel safe to express ideas and learn from mistakes (Smith, 2024; Chen & Patel, 2024). Family involvement—especially in the form of academic support and expectations—has likewise been linked to stronger mathematical self-beliefs (Chen & Patel, 2024).

The interaction between intrinsic and extrinsic factors is dynamic and mutually reinforcing. Intrinsically motivated students tend to seek out supportive external environments, while extrinsic support can cultivate internal motivation and self-belief. For instance, a motivated student who receives consistent encouragement from teachers and peers is likely to develop stronger mathematical confidence over time (Berger & Karabenick, 2011; Cho & Heron, 2015). Conversely, a lack of external support can weaken intrinsic motivation, even among students with high potential.

Understanding these dual influences is vital in crafting effective educational interventions. Strengthening both internal dispositions and external support mechanisms can lead to more confident, engaged, and successful mathematics learners.

### 3.3. Self-Efficacy and Confidence

Self-efficacy, defined as an individual's belief in their ability to succeed in specific tasks, plays a central role in shaping students' confidence in mathematics. It serves as the psychological foundation that influences how students approach problem-solving, persist through difficulties, and manage anxiety related to academic tasks. According to Mohamadi *et al*. (2011), individuals with strong self-efficacy are more likely to view challenges as opportunities to grow, thereby maintaining higher confidence and resilience in learning situations.

In mathematics education, self-efficacy is a strong predictor of confidence and academic performance. Students who believe they can solve math problems tend to exert more effort, utilize effective strategies, and recover quickly from setbacks (Beesley *et al*., 2018). Research also shows that students with high mathematical self-efficacy are more likely to select challenging tasks, demonstrating their belief in their competence (Zimmerman, 2000). This belief system promotes a positive feedback loop—confidence drives effort, and effort reinforces self-efficacy.

In contrast, students with low self-efficacy often avoid difficult tasks, experience higher levels of anxiety, and struggle to persist when facing obstacles. This can lead to a decline in confidence and academic outcomes. Studies in the Philippine context affirm that self-efficacy strongly correlates with confidence in mathematics, especially among junior and senior high school students (Valera *et al*., 2019; Domingo *et al*., 2020). These students tend to perform better academically because their belief in their abilities motivates them to engage more deeply with the material.

The link between self-efficacy and confidence is also mediated by mastery experiences—successful completion of tasks builds confidence, which in turn boosts self-efficacy (Carreon, & De Guzman, 2019). Additionally, vicarious experiences, such as observing peers succeed, and verbal persuasion from teachers and parents contribute to students' growing belief in their mathematical capabilities.

DOI: https://doi.org/10.17509/ijomr.v5i1.82065
p- ISSN 2776-608X e- ISSN 2776-5970

Overall, fostering self-efficacy is essential in enhancing students' confidence in mathematics. Interventions that promote mastery, provide positive reinforcement, and offer structured guidance are effective in strengthening both constructs and improving learning outcomes.

### 3.4. Influence of Learning Environment and Peer Interaction

The learning environment and peer interactions are critical extrinsic factors that significantly influence students' confidence in mathematics. A supportive and resource-rich learning environment fosters engagement, reduces anxiety, and encourages academic risk-taking, all of which are essential for building mathematical confidence. Classrooms that provide clear instruction, collaborative opportunities, and constructive feedback enable students to develop a sense of competence and belonging (Ziegler & Köller, 2020; Masika & Jones, 2016; Alesech & Nayar, 2021; Rahimi & Ong, 2023; Wu *et al.,* 2017).

Teacher support plays a pivotal role in shaping students' perceptions of their mathematical abilities. When students receive encouragement, individualized guidance, and affirmation from teachers, they are more likely to develop a positive self-concept and higher self-efficacy (Sherman *et al*., 2013). In the Philippine context, teacher-student interactions have been shown to significantly impact students' willingness to engage with challenging content, particularly in rural and under-resourced settings (Patalinghug *et al*., 2021).

Peer interaction is another influential factor. Students often derive confidence through collaborative learning, where peer support provides emotional reassurance and shared problem-solving strategies. Teamwork fosters a communal learning atmosphere, which not only enhances academic outcomes but also reinforces a sense of capability and belonging (Laguador, 2014). Studies have found that in high-performing educational systems such as Singapore and Finland, a strong culture of peer collaboration correlates with increased mathematical confidence (Chen & Patel, 2024; Smith, 2024).

Moreover, peer support helps normalize the struggle with complex mathematical concepts, reducing feelings of isolation and promoting resilience. Students who work with supportive peers are more inclined to seek help, share resources, and celebrate successes together. This dynamic contributes to the internalization of positive academic behaviors, ultimately reinforcing both self-efficacy and confidence.

In conclusion, the learning environment and peer interactions provide essential extrinsic support systems that enhance students' belief in their mathematical abilities. Educational strategies that promote inclusive classroom practices, foster collaboration, and prioritize teacher-student rapport are vital for nurturing a confident and motivated mathematics learner.

### 3.5. Interplay of Intrinsic and Extrinsic Factors

Students' confidence in mathematics is not the result of a single factor but rather a dynamic interplay between intrinsic and extrinsic influences. Intrinsic factors such as self-motivation, prior academic success, and positive self-concept form the foundation of mathematical confidence. These internal attributes drive students to engage with the subject, persist through challenges, and derive satisfaction from their accomplishments (Bermejo *et al*., 2019; Sidiq *et al.,* 2019). However, their effects are often amplified or constrained by external factors such as teacher support, classroom environment, and parental involvement.

The interaction between these domains is evident in how students internalize external feedback and experiences. For instance, a student with strong internal motivation may experience increased confidence when reinforced by supportive teacher feedback or

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p- ISSN 2776-608X e- ISSN 2776-5970

collaborative learning opportunities. Conversely, even a motivated student may suffer diminished confidence in a negative learning environment or when faced with discouraging peer dynamics (Nguyen & Nguyen, 2021).

In the Philippine context, studies have emphasized that while intrinsic motivation is a vital predictor of success, it must be complemented by extrinsic support to sustain high levels of confidence. Asuncion and Francisco (2020) noted that Filipino students who experienced prior academic success and supportive school environments were more likely to maintain high self-efficacy and confidence in mathematics. Similarly, Valera *et al*. (2019) reported that intrinsic motivation and positive classroom interactions jointly contributed to improved self-efficacy among high school learners.

The synergy between internal and external factors is also crucial for students facing high-stakes academic demands. Effective classroom strategies that provide emotional support, meaningful feedback, and opportunities for mastery help bridge the gap between students' internal beliefs and actual performance. When intrinsic and extrinsic elements align, they create a reinforcing cycle that builds self-efficacy and fosters greater academic confidence (Beesley *et al*., 2018).

Ultimately, this interplay highlights the need for holistic educational interventions that simultaneously cultivate internal motivation and provide external scaffolding. Addressing both dimensions ensures a more resilient and confident learner who is better equipped to succeed in mathematics.

### 3.6. Structural Equation Modeling Framework

To synthesize the complex relationships among intrinsic factors, extrinsic factors, self-efficacy, and students' confidence in mathematics, Structural Equation Modeling (SEM) is employed as a theoretical and analytical framework. SEM is a robust multivariate technique that integrates factor analysis and multiple regression, allowing for the simultaneous estimation of relationships among observed and latent variables (Kline, 2019). This method provides a comprehensive picture of how psychological and contextual variables interact to influence student confidence.

The conceptual model guiding this review posits that intrinsic and extrinsic factors both have direct effects on students' self-efficacy and confidence. Moreover, self-efficacy is theorized to mediate the relationship between these factors and students' confidence in mathematics. This mediation suggests that while motivation, parental support, classroom conditions, and prior achievement contribute to confidence, their effect is partly channeled through students' beliefs in their ability to succeed.

Several studies support the application of SEM in understanding confidence in mathematics. For example, Gurat (2018) utilized SEM to demonstrate how socio-economic background and classroom variables influence both mathematical competency and confidence among Filipino students. Likewise, Bautista and Cabilin (2021) applied SEM to identify how anxiety, support systems, and mastery experiences interact to shape students' confidence. Internationally, Anderson and Lopez (2024) used SEM to explore confidence patterns in Malaysian learners based on TIMSS 2023 data, confirming self-efficacy as a central mediating construct.

In the SEM framework, latent constructs such as intrinsic motivation and self-efficacy are measured using multiple indicators, such as self-concept, enjoyment, effort, and perceived utility of mathematics. Similarly, extrinsic factors are operationalized through variables like parental support, teacher interaction, and peer collaboration. These indicators feed into the

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p- ISSN 2776-608X e- ISSN 2776-5970

latent variables, which are then tested for convergent and discriminant validity to ensure that each construct is statistically distinct and meaningful (Hair *et al*., 2022).

The model fit is assessed using indices such as RMSEA, CFI, TLI, and SRMR, ensuring that the theoretical model adequately represents the empirical data. A well-fitting model allows for the validation of theoretical assumptions and provides actionable insights into how to enhance student confidence through targeted interventions.

Overall, SEM offers an effective lens through which the multifaceted influences on mathematical confidence can be understood. It emphasizes the interconnectedness of personal and contextual factors, supporting evidence-based strategies for improving confidence and academic success in mathematics.

### 3.7. Synthesis

The literature reviewed reveals that students' confidence in mathematics is influenced by a dynamic interplay of intrinsic and extrinsic factors, mediated by self-efficacy. Intrinsic factors—such as self-concept, motivation, and prior academic success—are shown to directly affect how students perceive their ability to succeed in mathematics. These internal attributes are crucial, as students who possess high motivation and a positive academic self-concept demonstrate stronger confidence in handling mathematical tasks (Bermejo *et al*., 2019; Dizon & Del Rosario, 2020).

Extrinsic factors—including teacher support, classroom environment, family involvement, and peer collaboration—also play a vital role in enhancing or undermining students' confidence. Positive reinforcement from teachers and family, combined with collaborative learning opportunities, can boost self-belief and reduce mathematics anxiety (Ziegler & Köller, 2020; Patalinghug *et al*., 2021). These contextual supports foster resilience and encourage sustained engagement with mathematical learning.

Self-efficacy emerges as a central mediating variable that bridges both intrinsic and extrinsic influences with confidence. Students who believe in their ability to succeed are more likely to embrace challenges, persevere through difficulties, and achieve higher performance levels (Beesley *et al*., 2018). In this framework, self-efficacy not only contributes to confidence but also strengthens the effects of both internal motivation and external support.

The application of Structural Equation Modeling (SEM) has enabled researchers to validate these interrelationships empirically. Models constructed using SEM consistently show strong fit indices, indicating that constructs such as self-efficacy, intrinsic motivation, and extrinsic support significantly predict confidence in mathematics (Gurat, 2018; Anderson & Lopez, 2024). These findings underscore the importance of integrating both personal and environmental factors into educational strategies.

In sum, confidence in mathematics is not a standalone attribute but the result of multifaceted, interacting influences. Effective interventions must address both the internal beliefs of learners and the external environments in which they are situated. Strengthening students' self-efficacy while fostering supportive learning conditions offers a comprehensive approach to improving mathematical confidence and, consequently, academic outcomes.

## 4. CONCLUSION

The literature reviewed in this study underscores that students' confidence in mathematics is a multidimensional construct influenced by both intrinsic and extrinsic factors. Intrinsic elements such as motivation, self-concept, and prior academic experiences significantly shape learners' belief in their ability to succeed in mathematical tasks. Extrinsic factors, including

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p- ISSN 2776-608X e- ISSN 2776-5970

teacher support, peer collaboration, classroom environment, and parental involvement, also play crucial roles in reinforcing or hindering mathematical self-confidence.

Furthermore, self-efficacy emerges consistently across the literature as a central mediator between influencing factors and students' confidence in mathematics. Students who exhibit high self-efficacy are more resilient in facing mathematical challenges and demonstrate greater persistence and academic achievement. The literature suggests that effective interventions should simultaneously enhance both intrinsic motivation and extrinsic support systems to develop a robust sense of self-efficacy and confidence in learners.

This review highlights the necessity for educational stakeholders to design student-centered programs, classroom practices, and school policies that cultivate a supportive learning environment, foster growth mindsets, and reduce mathematics anxiety. Doing so could lead to improved student engagement, performance, and long-term interest in mathematics and related disciplines.

## 5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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