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Investigating the Impact of Mathematics Anxiety on College Students' Learning and Performance

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Abstract

Mathematics anxiety (MA) is a psychological disorder that affects students' ability to participate in and complete mathematical tasks. This study used a mixed method (questionnaire survey and in-depth interview) to explore the relationship between math anxiety, self-efficacy and problem-solving ability among college students. The study used a combination of qualitative and quantitative data collection methods. Quantitative analysis found that math anxiety was negatively correlated with academic performance, confirming that higher levels of math anxiety were associated with poorer academic achievement. In addition, self-efficacy played a key mediating role in this relationship - students with high self-efficacy showed stronger problem- solving ability even when anxious. This study provides a new theoretical perspective for understanding math anxiety by linking math anxiety with cognitive load theory. Cognitive load theory holds that anxiety overconsumes brain resources, which are necessary for problem solving. The study focused on problem-solving ability and self-efficacy theory, which holds that students' perceptions of their own abilities have a decisive influence on their academic achievement. The results emphasize the need to simultaneously address anxiety and improve self-efficacy in education. Practical implications include: implementing targeted teaching interventions (such as anxiety relief strategies, confidence-enhancing exercises, positive reinforcement, mindfulness, and peer support) to create a supportive learning environment and improve students' psychological state and academic performance.

Keywords: Mathematics Anxiety, Self-Eficacy, Problem-Solving Ability, Cognitive Load Theory, Academic Achievement, Mixed Methods Research, Instructional Intervention.

Introduction

Background and Rationale

Mathematics is a necessary educational element and it has a vital role to play in diverse academic disciplines, including psychology, economics, and engineering (Dowker et al., 2016). Nonetheless, numerous pupils undergo high points of Mathematics Anxiety (MA), which considerably obstructs their performance and education (Ashcraft & Krause, 2007). Studies propose that MA adversely influences the working memory of pupils, their capacity to solve problems, and overall self-assurance. The mental weight connected with

MA often paves the way towards evading conduct, less involvement, and poorer success in mathematics courses (Beilock & Maloney, 2015).

Besides, an MA can develop early in learning contexts and continue into higher studies, impacting the career selections of the students and restraining their prospects in STEM sectors (Hembree, 1990). It is hinted by the latest research that students having high MA experience problems in mathematical calculations and face challenges in practical settings. It is crucial to address MA for enhancing the academic achievement of the students and long-standing career opportunities because mathematics skills are essential in numerous professions.

A solid association between MA and academic performance has been established by previous studies but its influence on self-efficacy and problem-solving performance have been given less importance. Self-efficacy, that is, anyone's belief that he can be successful in doing a particular task, plays a critical role in academic impetus and diligence (Bandura, 1997). Students who have low self-efficacy have more possibility of developing adverse attitudes toward mathematics. As a result, their performance becomes poor, and feel disengaged from educational undertakings. So, if the complicated relations between MA, problem-solving capacities, and self- efficacy are explored, then a more detailed comprehension of the way MA influences the learning effects of the students will be realized.

Problem Statement

Though the obstruction of MA to learning is recognized, the exact influence that it has on self-efficacy and problem-solving performance is yet to be explored. Prior research has highlighted either quantitative connections, for instance, statistical relations between MA and academic performance, or qualitative understandings, comprising the individual narratives ofthe students regarding their struggles with mathematics (Luttenberger et al., 2018). Nonetheless, a small number of researchers have included both standpoints to offer a rounded comprehension of the matter.

The shortage of empirical studies uniting emotional, cognitive, and inspirational issues is a key problem in addressing MA. Certain research focuses on the role of cognitive weight in intensifying MA (Sweller, 2010) but others highlight the emotive misery that goes together with mathematical tasks. The advancement of all-inclusive intervention tactics is restricted by this disjointed method.

Moreover, current studies often overlook the way diverse stages of self-efficacy intercede the rapport between MA and problem-solving performance. Pupils who have high self-efficacy may develop coping devices to mitigate the influence of MA. However, students with low self- efficacy might undergo a compounding outcome, weakening their mathematical capabilities more (Usher & Pajares, 2009). Scrutinizing this dynamic is critical for scheming targeted involvements that nurture self-assurance and spirit in learning mathematics.

The purpose of this paper is to address these gaps by using a mixed-method system that incorporates quantitative survey data from a huge pupil sample and qualitative perceptions

from detailed interviews. We strive to reveal the way MA illustrates the academic understandings of the students by doing so, the degree to which it impacts problem-solving proficiency, and the way self-efficacy moderates these effects. The outcomes will provide valued insinuations for educators, curriculum designers, and policymakers looking to enhance mathematics learning and decrease learning obstacles that are caused by anxiety.

Research Question

- How does mathematics anxiety impact students' problem-solving performance and self- efficacy among college students?

Significance of the Study

Mathematics anxiety (MA) is a rampant and persistent matter that affects a vital part of college pupils, yet its influence' s complete scope on individual welfare and academic performance needs to be analyzed more. The objective of this research is to fill these research gaps by implementing a mixed-methods system, incorporating qualitative and quantitative data to offer a detailed grasp of the effects of MA on the learning procedures and performance of the students in mathematics. The unification of objective data, for example, the relationship between MA levels and academic performance, with subjective perceptions collected from pupil interviews, will consider a further subtle analysis of the way MA is demonstrated in the academic lives of the students.

This research explores the complicated relations between MA and self-efficacy and will focus on the way feelings of anxiety may weaken the confidence of the students in their mathematical capabilities, possibly leading to a self-extending cycle of low performance and lesser impetus. The outcomes will have significant effects on the advancement of targeted involvement tactics that are based on empirical data and the subsisted know-how of the pupils. Such stratagems could involve anxiety-lessening classroom settings, mindfulness practices, or instructional techniques to improve the self-efficacy of the students in mathematics.

Besides, this research adds to the academic literature by including qualitative perceptions in the current body of studies on MA, which has conventionally shed light on quantitative data only. This research recognizes the subjective nature of anxiety and offers more affluent, setting- specific perceptions of the way pupils undergo MA by providing students with a voice through interviews. This inclusive method will assist in recognizing the fundamental matters that add to MA, which are often disregarded in further conventional research methodologies. Eventually, the findings from this research could apprise teacher training, curriculum design, and counseling services inside higher education institutes, offering proof-based recommendations for assisting pupils who undergo mathematics anxiety.

Literature Review

Understanding Mathematics Anxiety

As per Dowker et al. (2019), mathematics and anxiety (MA) is a persistent matter that impacts the learning results and cognitive processing of students, specifically in tasks that are related to mathematics. The schlars highlight that a number of gaps are present in comprehending the complete level of its influence, particularly regarding its long-standing consequences and the ethnic issues that may impact its advancement despite

the vital studies in the sector of MA, in turn necessitating further interdisciplinary outlooks and longitudinal research to advance successful interventions.

Mathematics anxiety (MA) has been acknowledged for a long time as a psychological state that adversely impacts the capabilities of students to be involved with mathematical ideas and perform mathematical tasks (Harahap et al., 2025). Richardson and Suinn (1972) opine that MA is delineated as a sense of strain and dread that impedes the management of numbers and resolving mathematical challenges. This concern can arise from diverse issues, comprising previous adverse know-how, an apparent shortage of capability, and social anticipations adjoining mathematical skills. It has been analyzed by Asare et al. (2025) that the restricting effect of mathematics anxiety and the intermediating role of pupil self-efficacy on the rapport between mental consciousness and math performance.

Cognitive Load Theory (Sweller, 1988) offers a framework for comprehending the cognitive influence of mathematics anxiety, proposing that anxiety posits extra demands on working memory, hence lessening the capability of the students to process data and resolve difficulties successfully. This is in line with Ashcraft and Krause (2007), who contend that MA unsettles working memory resources, paving the way to amplified faults and slower speediness of problem-solving. MA's high stages weaken instant mathematical performance and add to long-standing evading conduct, lessening the inclination of students to engage with mathematics in academic and practical settings (Hembree, 1990).

These cognitive effects are supported more by neurological research. According to Lyons and Beilock (2012), students having high MA display less activity in the amygdala, which is a part of the brain that is connected with processing fear especially when they face mathematical tasks. This neural reply is connected with intensified physiological anxiety, which obstructs cognitive functioning and mathematical performance more. The innate influence of MA is focused on such findings, spreading away from just fear to real neurocognitive intervention.

Moreover, the early experience's role in the advancement of MA has been extensively analyzed. Beilock and Maloney (2015) propose that adverse early happenstances with mathematics, for instance, harsh criticism from parents and tutors, can add to the construction of mathematics anxiety. Besides, Gunderson et al. (2011) focus on the role of the approaches of the parents, displaying that children whose parents convey their math-associated fears are inclined to cultivate analogous anxieties. It is proposed by these findings that MA is not simply a personal matter; it is a communally strengthened occurrence that can be spread throughout generations.

Gender distinctions have been widely researched in MA too. Studies indicate that female pupils are inclined to have more MA levels compared to males, despite accomplishing related or even greater levels of mathematical ability (Else-Quest et al., 2010). As a likely elucidation, stereotype threat (Steele, 1997) has been suggested, proposing that social beliefs regarding gender and mathematical skills may add to more levels of anxiety in female pupils. Nonetheless, it is vital to indicate that real performance differences are less steady

whereas gender distinctions in self-reported MA are well-recognized, hinting that anxiety may unduly impact self-assurance instead of skills. It has been analyzed by Wang (2024) the way a sense of being in the right place and formative evaluation tactics can help lessen the negative consequences of educational anxiety in mathematics, focusing on their role in nurturing a supportive learning context and enhancing pupil outcomes.

Overall, MA is an intricate matter impacted by neurological, educational, cognitive, and social issues. Comprehending the origins and contrivances of MA is critical for mounting successful interventions that can lessen its adverse effects and advance the mathematical performance of students.

Impact ofMathematics Anxiety on Problem-Solving

A number of research have displayed the negative consequences of mathematics anxiety (MA) as far as problem-solving performance is concerned. McLeod and Adams (1989) talked about the effect of mathematical problem-solving from a fresh standpoint. They analyze the way outlooks, emotions, and beliefs impact the capacity of students to be involved with and solve the difficulties in mathematics. The vitality of addressing emotional matters together with cognitive tactics to enhance mathematical learning effects is emphasized by their work. As per Xolocotzin (2017), feelings like anxiety and frustration have the ability to vitally influence the capacity of a student to be involved with and maintain mathematical notions. If educators comprehend these emotive issues, they can generate more supportive learning contexts that address cognitive and emotive requirements (Xolocotzin, 2017).

It was found by Beilock and Maloney (2015) that pupils having high stages of MA are inclined to display slower reaction times and lesser accuracy when finalizing mathematical tasks. This deficiency in problem-solving capability may be because of the intensified cognitive load that MA inflicts on pupils, restricting their capacity to emphasize the mathematical procedure and guiding them to errors or evading tasks completely. It is proposed by the cognitive load theory that the anxiety undergone by pupils inhabits working memory assets, which are crucial for performing mathematical processes and solving problems precisely.

In addition, Hembree (1990) emphasizes that MA is often connected with evading conduct, in which pupils intentionally evade involvement with mathematics-associated tasks or subjects because of the adverse feelings that they undergo. Such evading can give rise to a self- fulfilling prediction, in which the shortage of practice and exposure to mathematical challenges merely worsens the anxiety of students, making it gradually tough for them to execute properly in mathematics. This cycle of evading prolongs the adverse influence of MA on pupils' self- assurance and their capacity to resolve mathematical difficulties. It is proposed by the cognitive interference theories that working memory resources are consumed by anxiety-associated notions, which are crucial for successful mathematical problem-solving (Ashcraft & Kirk, 2001). This indicates that pupils who undergo high MA may struggle to recover related mathematical knowledge or use rational reasoning tactics successfully, in so doing, paving the way to amplified errors in calculation and problem-solving. Moreover, Lyons and Beilock (2012) applied neuroimaging methods to display that MA triggers areas of the brain connected with

agony and dread rejoinders, further strengthening the evading of mathematics-associated tasks. Usually engaged in emotive processing, these brain areas obstruct the ability to be involved in successful problem-solving.

Studies by Gunderson et al. (2011) also propose that MA is connected with physiological stress reactions, for example, amplified heart rate and cortisol levels, which can damage cognitive functioning more while performing mathematical tasks. These physiological demonstrations may interpret why pupils with MA do considerably worse on scheduled problem- solving tests in comparison to those having low levels of anxiety. A feeling of earnestness is created by the intensified physiological urging, which aggravates anxiety and harms the capability of students to ruminate transparently and reason through difficulties.

Besides, gender distinctions in the influence of MA on problem-solving have been analyzed in diverse research. A meta-analysis was piloted by Else-Quest et al. (2010) and found that MA affects irrespective of whether they are male and female pupils but it has a tendency to influence the females more, perhaps because of social typecasts and lesser self-insights of mathematical competence. Such outcomes focus on the significance of addressing MA at the cognitive and emotive stages to enhance mathematical performance and problem-solving skills among pupils. The differential influence of MA grounded on gender highlights the necessity for targeted involvements that think through gender-based understandings and inspire male and female pupils to improve constructive outlooks toward mathematics.

Based on these outcomes, it is obvious that addressing the emotive, cognitive, and physiological facets of mathematics anxiety is crucial to enhancing problem-solving skills in mathematics. Attempts to lessen the cognitive load prompted by MA and nurture a supportive learning context may be necessary for reducing its influence on the academic performance of students in mathematics.

Mathematics Anxiety and Self-Eficacy

Bandura's (1997) self-efficacy theory speculates that people with high self-efficacy – the faith in their competence – are not afraid of difficulties and perform skillfully in tough tasks. By contrast, pupils with low self-efficacy tend to avoid and may surrender more simply when challenged with mathematical problems. Studies have constantly displayed a solid adverse relationship between mathematics anxiety (MA) and self-efficacy, proposing that pupils who undergo high stages of MA tend to distrust their mathematical skills, which obstruct their performance more.

It was found by Betz and Hackett (1983) that pupils with high MA are inclined to have reduced self-assurance in their mathematical competence, which paves the way to lesser success and perseverance when solving mathematical difficulties. This shortage of self-assurance nurtures a self-continuing round: low self-efficacy creates poor performance, which sequentially strengthens MA, lessening self-efficacy more. Pajares and Miller (2014) stretched this notion by illustrating that self-efficacy faiths are a sturdier forecaster of mathematical performance than real competence, highlighting the psychological element of mathematical accomplishment. Their work proposes that nurturing a constructive self-idea

and faith in one's individual abilities can have a deep influence on mathematical success, irrespective of the primary competence level of the student.

Besides, outcomes from Hoffman and Schraw (2009) propose that MA mitigates self-efficacy and impacts the metacognitive parameter – the capacity to observe and regulate one's cognitive procedures while solving mathematical difficulties. Pupils who have low self-efficacy may struggle to be involved in operational learning tactics, intensifying the performance matters more. If the students do not have the self-assurance to assess their own problem-solving systems or identify errors, they may continuously face problems, strengthening the cycle of anxiety and low performance.

Intervention tactics should highlight improving self-efficacy while addressing MA at the same time to break this cycle. Cognitive-behavioral approaches like constructive reinforcement, mindfulness exercises, and goal-setting have been effective in enhancing the confidence of the students in their mathematical skills (Ashcraft & Krause, 2007). Furthermore, mastery understandings, in which pupils are involved in small, attainable mathematical accomplishments offer pupils solid proof of their flourishing skills, strengthening their faith that they can be successful in mathematics.

Educators can execute peer monitoring programs also, offering pupils role models who have effectively defeated MA, strengthening the faith that advancement is probable. Peer tutors can provide direction, share managing tactics, and create a supportive context in which pupils feel safe to take risks and make blunders with no dread of judgment. This type of societal assistance can be effective in deciphering the process of learning and mitigating outlooks of seclusion or shortfall.

Pupils can grow a better rapport with mathematics by incorporating self-efficacy-advancing tactics with MA-lessening methods, enhancing their self-assurance and performance. This dual system has the ability to improve mathematical skills and nurture a further constructive and vested outlook toward learning, eventually creating the stage for long-standing academic accomplishment.

Existing Research Gaps

There have been plenty of studies on mathematics anxiety (MA). However, there are still noticeable gaps that need to be addressed. Much of the present studies have highlighted statistical relationships between MA and academic performance or qualitative research that analyzes the individual know-how of pupils with anxiety. Nonetheless, a small number of research have effectively incorporated qualitative and quantitative techniques to offer a more detailed comprehension of the matter. Akram et al. (2021) highlights the necessity for mixed- methods research that unites the objective consistency of quantitative exploration with the opulent, subtle perceptions that the qualitative data offer. This approach would allow researchers to explore not only the statistical relationships between MA and student performance but also the subjective experiences and coping mechanisms of students who struggle with anxiety.

One significant gap lies in the exploration of how MA manifests across different age groups and educational levels. While much research has been conducted at the primary

and secondary school levels, less attention has been given to how MA affects students in higher education and beyond. As students transition into university or the workforce, the pressure to perform in mathematics-related subjects or tasks may intensify, and understanding how MA evolves at these stages could help develop targeted interventions. For example, students pursuing careers in fields such as engineering, finance, or technology may face heightened anxiety due to the expectations associated with advanced mathematical skills. Future studies should examine how MA develops throughout a student's academic career and its potential effects on career choices and job satisfaction.

Additionally, most studies have examined MA in Western educational contexts, with limited research on how cultural and societal factors influence students' experiences with mathematics anxiety. Cross-cultural comparisons are essential for understanding whether the sources and consequences of MA are universal or vary based on cultural norms, educational expectations, and societal attitudes toward mathematics (Furner & Duffy, 2002). For instance, East Asian countries with high academic expectations in mathematics may have different manifestations of MA compared to Western countries where mathematics anxiety is often linked to early negative experiences in school settings (Dowker et al., 2016). Cultural differences in how success and failure in mathematics are perceived and how educational systems handle academic stress could contribute to variations in MA. Future research should examine how educational systems, parental expectations, and cultural attitudes contribute to the development and management of MA across different regions.

Another critical gap in the literature is the lack of longitudinal studies examining the long-term effects of MA on students' academic trajectories and career choices. Most studies rely on cross-sectional designs, which provide a snapshot of the relationship between MA and academic performance but do not account for how these effects evolve. Longitudinal research could shed light on whether early interventions can mitigate the negative effects of MA and whether students who experience MA in early education continue to struggle with mathematics- related tasks in higher education and professional settings (Ma, 1999). This type of research would be particularly valuable in assessing the long-term impact of MA on students' overall academic confidence and career outcomes.

Furthermore, while research has identified various coping strategies that students use to manage MA, there is a need for a more detailed examination of which coping mechanisms are most effective in different contexts. Studies such as those by Gunderson et al. (2011) have suggested that expressive writing and mindfulness practices can help alleviate MA, but more research is needed to determine the long-term effectiveness of these interventions across diverse student populations. For example, mindfulness exercises may be advantageous to a few pupils, whereas others may like problem-solving techniques or peer assistance that are more active. A more profound exploration into the circumstantial matters that impact the significance of coping tactics would assist in offering a more subtle comprehension of how to support pupils in the best possible manner.

There is also a requirement for research that evaluates the role of digital education gadgets and artificial intelligence-based teaching approaches in lessening MA, especially as technology has a growingly fundamental role to play in mathematics learning. At present,

pupils can be involved with mathematics in further self-paced and customized contexts since they can easily use virtual platforms and adaptive learning tools. By providing instant responses and breaking down intricate ideas into convenient phases, these tools could offer personalized assistance to help pupils defeat anxiety. Imminent research should analyze the way digital involvements might lessen MA and improve the confidence of the students in their mathematical skills, especially for pupils who undergo intense anxiety or shortage of conventional support methods.

More collective and ethnically responsive intervention tactics can be improved by addressing these research gaps that successfully lessen MA and assist pupils in defeating their anxiety-associated problems. Scholars can widen the scope of studies to integrate varied populations, learning environments, and longstanding consequences add to a further detailed comprehension of MA, and create proof-based answers that nurture better accomplishment and welfare among pupils.

Methodology

Research Design

This research used a mixed-methods system, including qualitative and quantitative data to offer a meticulous comprehension of the influence of mathematics anxiety (MA) on the self- efficacy and problem-solving performance of pupils. The unification of survey data and qualitative interviews paved the way for the results' triangulation, improving the legitimacy and productivity of the findings. The quantitative element of the studies targeted to recognize the degree of MA and its relationship with academic performance, highlighting GPA and self- efficacy levels. This element helped to collect numerical information that enumerated the correlation between levels of performance and MA. Conversely, the qualitative ingredient engaged in meticulous interviews and offered a more affluent, more subtle analysis of the individual experiences ofthe students with MA. These qualitative perceptions were influential in comprehending the way MA is demonstrated in the everyday academic lives of the students and its supposed influence on their mathematical skills and managing tactics.

The reason for selecting this mixed-methods design was to consider a detailed analysis of the occurrence and mental influence of MA on pupils. The research united these two methodologies and aimed to recognize statistical trends and capture the individual and subjective facets of MA, which are often disregarded in decently quantitative research.

Participants and Sampling

- **Survey**: With a sample of 300-400 college pupils selected from diverse disciplines at a huge public university, the survey was piloted. To confirm that the sample was various concerning academic backdrop, gender, and diverse stages of mathematics-associated anxiety, a stratified sampling approach was applied. Stratification assisted in confirming that the sample was illustrative of the general pupil populace, seizing an extensive gamut of understandings with MA, from those having less anxiety to those undergoing high echelons of anxiety. This multiplicity assisted in ensuring that the results could be generalized to a larger populace of university pupils.

- **Interviews**: In the survey, ten students were selected for semi-structured interviews based on extreme MA levels recognized. These respondents were cautiously selected to characterize the MA scale's both ends – students with high MA and students with less MA. This choice helped in comparing their lived understandings, coping tactics, and insights into the influence of mathematics anxiety on their educational performance. The interviewees were diverse in concerning their educational performance and coping tactics, which offered a prospect to analyze if the coping tactics of the students were connected with their levels of MA and academic success.

The purposive sampling tactics for interviews permitted the research to highlight respondents who could give the most affluent perceptions of the way MA impacts academic results and the way pupils handle emotive as well as mental difficulties akin to mathematics.

Data Collection Instruments

- **Survey**: To measure the levels of MA, the study used the Mathematics Anxiety Rating Scale (MARS) developed by Richardson and Suinn (1972), a widely used and validated tool for assessing MA in students. The MARS consists of a series of items that measure students' self-reported feelings of anxiety when faced with mathematics tasks, including tests and problem-solving situations. In addition to the MARS, the survey also included a self-efficacy scale (Bandura, 1997), which assessed students' confidence in their ability to succeed in mathematics-related tasks. This scale was designed to provide insight into the students' belief in their mathematical competence, which is often closely linked to anxiety levels.
- **Interviews**: The semi-structured interviews were designed to explore students' personal experiences with MA in greater detail. A set of open-ended questions was used, allowing participants to discuss how they experienced MA in academic settings, how it affected their problem-solving abilities and the coping strategies they employed. The interview protocol was designed to be flexible, giving the interviewer the ability to follow up on interesting or unexpected responses. For instance, the interviews explored themes such as the role of past experiences with mathematics, the influence of teaching styles, and how students perceived the relationship between anxiety and their academic performance. This approach provided an opportunity to gather detailed, context-rich data about students' emotional responses to mathematics and the ways in which MA affects their behavior and academic engagement.

Data Analysis

- **Quantitative Analysis**: The quantitative data collected from the survey was analyzed using descriptive statistics to summarize and describe the overall patterns of MA levels and self-efficacy scores among participants. Measures such as mean, standard deviation, and frequency distributions were used to describe the distribution of MA across the sample. To explore the relationship between MA and academic performance, correlation analysis was conducted to examine the strength and direction of the relationship between MA and self-efficacy scores, as well as between MA and GPA. Regression analysis was employed to identify the extent to which MA could predict students' performance on problem-solving tasks. This approach allowed for the exploration of causal relationships and provided evidence for how MA may influence students' academic success.

- **Qualitative Analysis**: The interview data was analyzed using thematic analysis (Braun & Clarke, 2006), a widely used qualitative analysis technique that focuses on identifying, analyzing, and reporting patterns (themes) within the data. Thematic analysis was chosen because it allowed for an in-depth exploration of students' experiences with MA and their coping strategies. The process involved reading and re-reading the interview transcripts to familiarize oneself with the data, and then coding the data to identify key themes. As the analysis progressed, the codes and themes were refined and grouped into categories that represented significant aspects of students' experiences with MA. The themes that emerged from the analysis included avoidance behaviors, self-doubt, lack of confidence, and coping strategies such as seeking external help or relying on intrinsic motivation. The goal of the thematic analysis was to provide rich, detailed insights into how MA influences students' behaviors and emotional responses in mathematics and how they attempt to manage their anxiety.

Results

Mathematics Anxiety Levels and Self-Eficacy (Survey Findings)

Between mathematics anxiety and self-efficacy ($r = -0.45$, $p < 0.05$), a vital negative correlation was visible. This result suggests that as MA increases, students' confidence in their ability to succeed in mathematical tasks decreases, further supporting the theory that high MA impairs students' self-perception of their capabilities.

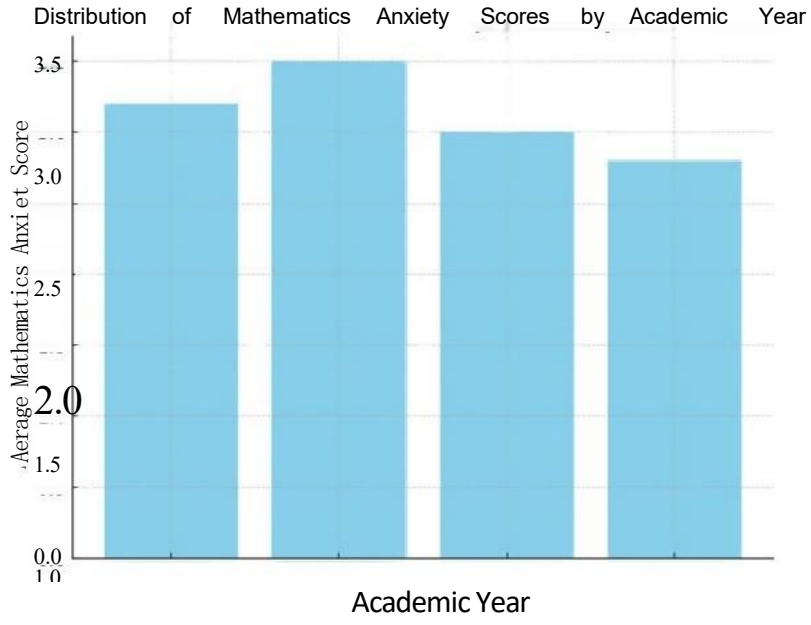

Figure 1 depicts the distribution of Mathematics Anxiety(MA)scores across students in different academic years.Freshman students exhibit the highest levels of MA,followed by sophomore students,while junior and senior students show progressively lower MA scores.This trend suggests that MA may decrease as students advance through their academicjourney.

Correlation between MA and Academic Performance

Higher MA levels were associated with lower academic performance.This correlation further highlights the detrimental effect of MA on students'ability to excel academically in mathematics-related subjects.The mean GPA across different levels of MA reveals the following trends:

The mean differences in performance across MA levels are as follows:

Mathematics Anxiety Level	Average GPA
Low	3.5
Moderate	2.8
High	2.1

The mean differences in student performance across varying levels of mathematics anxiety (MA) are measured by average Grade Point Average (GPA). The data reveal a clear negative relationship between MA and academic performance, with students experiencing higher levels of MA exhibiting lower GPAs. Particularly, pupils having low MA displayed the best average GPA (3.5), hinting that low anxiety stages may lead to better and sturdier academic results in mathematics-associated subjects. On the other hand, pupils having moderate MA had a substantially lower average GPA (2.8), proposing that even moderate stages of anxiety have the power to stop mathematical performance to a remarkable degree. The most extensive fall in GPA is noticed among pupils having high MA, who scored a 2.1 average GPA, emphasizing the extreme influence of anxiety on academic success. This trend is in line with earlier studies proposing that MA intervenes with working memory, cognitive processing, and skills in solving problems, eventually paving the way to declining academic performance (Beilock & Maloney, 2015). The perceived distinctions in GPA throughout the levels of MA support the argument that interventions aiming to decrease MA could play a vital part in enhancing the results of the students. It is also proposed by these findings that addressing MA through tactics like peer mentoring, confidence-construction exercises, and cognitive-behavioral systems may help lessen its adverse consequences on the performance of the students (Ashcraft & Krause, 2007). Moreover, the data focus on the significance of previous intervention and identification for pupils undergoing high MA, as persistent anxiety may add to continuous educational tussles and evading of mathematics-associated coursework. Thus, the findings put forward in Table 1 strengthen the important contrary rapport between mathematical anxiety and educational performance, offering empirical assistance for the requirement to execute targeted academic and mental tactics to mitigate mathematics anxiety and improve the success of the students.

Qualitative Insights

Common themes from the interviews included the avoidance of math courses and reliance on outer assistance, for example, teaching or searching for help from classmates. These strategies were often employed by students to cope with feelings of anxiety and to overcome academic challenges in mathematics. Some students mentioned that they tried to avoid situations where they would have to engage in math tasks due to the overwhelming feelings of fear and tension.

Bar Chart 2:Relationship Between Coping Strategies and Performance Levels

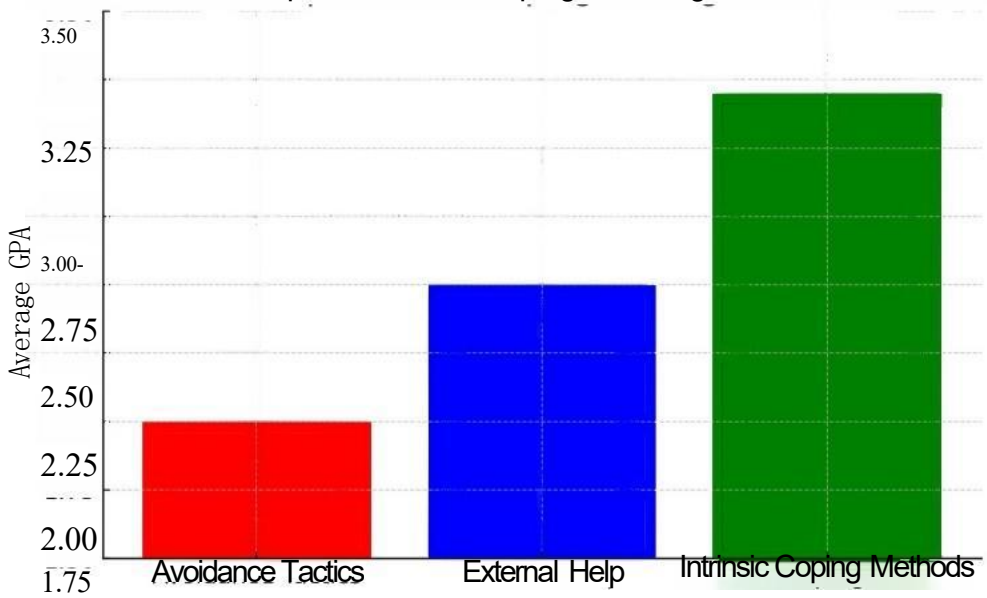

Figure 2:Relationship Between Coping Strategies and Performance Levels

Figure 2 illustrates the relationship between different coping strategies and student performance levels,measured by average GPA.The bar chart indicates that students who employed intrinsic coping mechanisms—such as self-regulation,motivation,and cognitive reframing—achieved the highest academic performance,as reflected in their superior GPA scores.This finding aligns with prior research suggesting that students who actively engage in problem-solving and self-efficacy-building techniques tend to perform better academically (Bandura,1997).The second group,consisting of students who relied on external help,such as tutoring,peer support,or teacher guidance,demonstrated moderate academic performance. Indeed,outer support offered a transitory defense against MA but failed to completely diminish its influence,perhaps because of the continuous reliance of the students on outer strengthening instead of internalized learning tactics like detachment,putting off,or curtailing exposure to mathematical tasks,displayed the lowermost GPA scores,strengthening the idea that avoidance- grounded management tactics are not fruitful and add to academic under accomplishment (Hembree,1990).

These outcomes focus on the critical role of adaptive managing tools in academic accomplishment and propose that interventions should emphasize nurturing inherent coping abilities while accompanying them with organized outer assistance when required.Besides, the differences in performance levels among the three categories focus on the necessity for educators to execute aimed tactics targeted at mitigating evading conduct and inspiring students to improve self-assurance and resilience in their mathematical skills. Precious perceptions are offered by these results into the efficiency of diverse coping tactics and highlight the significance of addressing MA through collective and practical learning interventions.

Discussion

Interpretation of Findings

Prior studies are supported by this research's findings that mathematics anxiety (MA) adversely influences cognitive functions and educational results (Batchelor, 2016). Particularly, the negative relationship between MA and self-efficacy authorizes that pupils who have higher stages of anxiety have less faith in the fact that they can be successful in mathematics; as a result, their academic performance is damaged. This aligns with previous research that proposes MA impedes cognitive resources essential for successful problem-solving (Ashcraft & Krause, 2007). The outcomes of this research strengthen the vitality of addressing anxiety and confidence- forming interferences inside learning environments as self-efficacy has an important role to play in student determination and success.

Besides, the vital distinction in GPA throughout diverse stages of MA is in line with prior research illustrating that MA has the power to weaken academic accomplishment (Beilock & Maloney, 2015). Students having high MA obtained poor GPAs, proposing that anxiety is an emotive and mental burden and a vital obstruction also to academic accomplishment. This finding' s implications go further than mathematics courses, since meager performance in mathematics may impact overall academic routes, comprising entrance to STEM-associated professions and sectors of study. This highlights the necessity for aimed tactics that can efficiently address and decrease MA, making sure that pupils do not fail to benefit from forthcoming academic and career prospects because of unsettled anxiety.

The qualitative interviews offered profound perceptions into the lived understandings of the students, focusing on the study subject matters of evading conduct, which further substantiates the notion that MA impacts the immediate performance of the students and their long-standing involvement with mathematics. A lot of pupils reported vigorously evading mathematics courses or assignments, which is in line with the MA's cognitive-evading models, in which anxiety prompts an aspiration to avoid math-associated tasks (Hembree, 1990). Evading conduct can generate a self-prolonging cycle in which pupils are disinvolved from mathematical education prospects, strengthening their anxiety further and restricting their capacity to grow skills in mathematics. These findings' effects propose that prior interventions are essential to stop pupils from developing deep-rooted evading patterns that could obstruct their academic advancement.

The rapport between coping tactics and performance showed that pupils who used inherent coping tactics, for example, searching for inherent inspiration, self-regulation, and applying metacognitive stratagems, tended to accomplish better in comparison to those depending basically on evading strategies or outer assistance. Prevailing research is supported by the finding proposing that adaptive coping tactics can lessen the influence of MA (Bandura, 1997). Inherent coping tactics like involving in constructive self-talk, setting attainable objectives, and practicing anxiety management methods, possibly assist students in forming self- efficacy and resilience, which are necessary for defeating difficulties in mathematics. These stratagems enhance performance and nurture a further constructive outlook toward mathematical education, which may have long-standing advantages.

Remarkably, pupils who depended hugely on outer assistance, for instance, peer support, tutoring, or parental assistance, displayed adequate academic performance. These tactics offered temporary respite and immediate academic advantages but they were not able to address the MA's original causes. Pupils who relied entirely on outer assistance often lacked the self- assurance to handle mathematical problems self-sufficiently, making them susceptible to anxiety in high-stress circumstances like examinations. This finding focuses on the significance of uniting outer support with inherent coping tactics to ensure long-standing accomplishment in defeating MA. Programs incorporating outer assistance with skill construction in self-regulation and emotive resilience may be specifically efficient in assisting pupils to improve a viable system for handling MA.

In a nutshell, this research focuses on the multilayered influence of MA on academic performance, self-efficacy, and involvement with mathematics. It is hinted by the results that interventions should highlight decreasing anxiety and nurturing constructive coping tactics and longstanding self-assurance in mathematical skills. Prospective studies should analyze the maneuvers through which diverse coping tactics impact academic results and recognize the most efficient manners to incorporate mental and learning interventions for pupils who undergo MA.

Educational and Psychological Interventions

Educators can execute varied tactics targeted at decreasing anxiety and nurturing a constructive educational setting to diminish the consequences of mathematics anxiety on the academic performance of the students. Confidence-construction exercises, for example, interactive problem-solving sessions, constructive strengthening methods, and group discussions can be helpful in the way students encounter their dreads and construct self-efficacy in mathematics (Ashcraft & Krause, 2007).

These undertakings offer prospects for pupils to obtain self-assurance in a helpful, low- stress environment, which assists in decreasing feelings of anxiety and improves their faith in their mathematical skills. Besides, instituting a classroom setting that focuses on mistakes as learning prospects can assist in decreasing the dread of failure, making pupils more relaxed in involved with mathematical difficulties.

Furthermore, programs such as peer mentoring, in which pupils who have defeated MA help others, can form a cooperative set-up and diminish feelings of seclusion. Peer mentoring has been displayed to enhance the self-respect and inspiration of the students (Betz & Hackett, 1983), offering a valued resource for those who struggle with MA. The peer mentors and mentees' collective experiences may assist in deciphering the procedure of defeating MA, making it a further attainable objective. These programs offer emotive assistance and provide pragmatic counsel on efficient research tactics and coping strategies. The mutual nature of peer mentoring provides the mentors with privileges also, since it strengthens their comprehension of the element and improves their self-confidence.

Other approaches that can help decrease the levels of anxiety are: cognitive-behavioral interventions (CBIs) or relaxation methods and mindfulness practices (Beilock & Maloney, 2015). These interventions assist pupils in handling the physiological symptoms

of anxiety, for instance, quick heartbeat and shallow breathing, which have the ability to interfere with cognitive processing. For example, mindfulness practices like concentrating on the current instant and practicing profound breathing exercises can be helpful in restructuring their insights of mathematics as a difficult yet manageable task, instead of an undefeatable hurdle. By improving pupils' consciousness of their anxiety triggers and instructing them on the way to control their emotive retorts, CBIs can authorize pupils to take control of their nervousness and enhance their concentration during mathematical tasks.

Additionally, educators should nurture inherent inspiration by focusing on the practical uses of mathematics and outlining it as an obtainable competence, instead of a frightening problem. By linking mathematical notions with the everyday lives, prospective careers, and the interests of the students, educators can offer pupils a feeling of persistence and significance, which may assist in diminishing feelings of dread. For example, teachers can exhibit the way mathematics plays a vital role in sectors like engineering, economics, technology, and healthcare, inspiring pupils to see the subject as a necessary instrument for solving problems in diverse occupations. When pupils view mathematics as openly connected with their individual purposes and objectives, they are more possibly to be involved in the element and persevere through difficulties.

Besides, providing adaptive educational tools, for example, interactive virtual platforms or learning software, can offer pupils customized educational experiences personalized to their personal requirements. These platforms can provide immediate responses, let pupils improve independently, and put forward mathematical difficulties in a manner that decreases the apparent problem. Such instruments assist students in solving problems with no stress of performing before others, hence diminishing anxiety.

By nurturing a constructive rapport with mathematics and assisting pupils in improving adaptive coping tactics, the adverse effects of MA can be vitally lessened, enhancing performance and the outlooks ofthe students toward the subject. Pupils who use these tactics can do better in mathematics courses, feel confident in managing mathematical difficulties, and perceive the subject as an obtainable competence instead of an undefeatable obstruction. With time, this can add to long-standing academic accomplishments and improve the confidence ofthe students in following STEM-associated sectors, which are often viewed as unapproachable because of the predominance of mathematics anxiety. Furthermore, a further wide-ranging and supportive educational context may be endorsed by such interventions, facilitating students throughout diverse demographic backdrops and academic competence.

In its entirety, addressing MA through learning and mental interventions is critical for enhancing instant academic performance and for nurturing enduring competence that students can use as far as academic and occupational sectors are concerned.

Conclusion & Future Research Directions

This research has offered valued perceptions into the rapport between mathematics anxiety, academic performance, and self-efficacy. The findings highlight the adverse influence of mathematics anxiety on mental processes and educational effects,

validating the significance of addressing mathematics anxiety as an obstacle to the academic accomplishment of the students. By including qualitative and quantitative approaches, this research has also focused on the efficiency of coping tactics, with inherent coping techniques displaying the most pledge in enhancing the performance of the students. These findings propose that nurturing self-regulation and inherent inspiration can be helpful in defeating the cognitive difficulties that MA poses, eventually improving their academic accomplishment in mathematics. Besides, the research highlights the significance of lessening the disgrace adjoining mathematics anxiety and forming a cooperative context that inspires students to search for assistance with no dread ofjudgment.

A solid requirement for targeted interventions in learning environments is prevalent since mathematics anxiety is something so complicated and it has extensive consequences. The elements that could help diminish mathematics anxiety include peer mentoring, confidence construction, and mindfulness-grounded systems. These can enhance the academic performance of the students and their outlook toward mathematics. These interventions address the mental obstructions and assist in improving adaptive coping tactics that make the students further resilient when they encounter mathematical problems. Moreover, generating a classroom ethos that regularizes failure and struggles in the educational procedure could be effective in lessening the dread of making blunders, permitting pupils to be involved in mathematics rather independently.

Future Research Directions

Prospective studies should analyze the long-lasting influences of mathematics anxiety, tracking pupils over time to evaluate the way it goes forward and the way its consequences on academic performance alter as pupils develop through their learning. Comprehending these longitudinal trends could offer a further in-depth comprehension of the role of mathematics anxiety in forming academic routes. Besides, cross-cultural variants in mathematics anxiety should be scrutinized, as students may undergo and manage mathematics anxiety in different manners in diverse cultural environments. Studies could explore the way ethnic outlooks towards mathematics, learning approaches, and social stresses impact the levels of anxiety and coping maneuvers of the students. Prospective research can add to the growth of generally appropriate tactics for decreasing mathematics anxiety.

Lastly, a prospect is there to analyze the rapport between mathematics anxiety and other aspects like socioeconomic rank, gender, and previous exposure to mathematics-associated problems. Exploring the way these issues interrelate with mathematics anxiety could provide a profound comprehension of the source causes of mathematics anxiety and lead to more personalized interventions. For instance, research could scrutinize the way gender disparities in mathematics anxiety may demonstrate or the way socioeconomic rank might impact the access of the students to resources and assistance systems that mitigate anxiety. In addition, comprehending the family background's role and previous academic understandings in forming the pupils' insights into mathematics could inform further operational intervention programs.

To sum up, it is crucial to address mathematics anxiety to confirm that every student has the prospect of being successful in mathematics, a subject that is essential for their academic

and occupational lives. Educators and policymakers can expand studies in this sector to polish intervention tactics and assist in nurturing a further cooperative and less anxiety-filled educational context for every student. Constant analysis of the causes, consequences, and interventions of MA will help generate a learning environment in which every student, irrespective of backdrop, can assuredly be involved in mathematics. Such attempts will enhance mathematical performance and improve the overall academic well-being and individual advancement of the students.

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