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RESEARCH ARTICLE

Fear of numbers: How learners overcome mathematics anxiety through positive teaching practices and instructional intervention

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ABSTRACT

Mathematics anxiety is a common and distressing issue among students that significantly affects their attitudes and performance in mathematics. It is characterized by feelings of tension, fear, and concern when dealing with math tasks, and these emotions can impair cognitive processing and problem-solving abilities. Effective classroom management and positive teacher-student relationships are critical in mitigating mathematics anxiety. This paper explored the experiences of high school students in classrooms that reduced their anxiety in mathematics. High school students (n=16) were purposively sampled to be interviewed in this study. Students' narratives indicated that when teachers demonstrated understanding, created an inclusive environment, and expressed confidence and enthusiasm about the subject, students felt safe to engage with the material without the fear of embarrassment. This supportive atmosphere encouraged active participation, normalized mistakes, and promoted a growth mindset, ultimately reducing anxiety. This approach not only built students' confidence but also created a sense of community, making students feel less isolated in their difficulties with math. Three major strategies were identified: simplification, collaboration, and interactive learning. Simplification involved breaking down complex topics into manageable steps, which helped reduce anxiety and improve understanding. Collaboration highlighted the benefits of group work, where peer support and discussion facilitated a communal learning experience and reduced anxiety around problem-solving. Interactive learning focused on engaging students through practical applications and real-world scenarios, making math more relevant and less abstract. These strategies contributed to a more positive learning experience by making math more accessible and encouraging active participation.

Keywords: classroom management; instructional practices; mathematics anxiety; teacher-student relationship

1. Introduction

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Mathematics anxiety is a pervasive and debilitating issue affecting many students, with implications that extend beyond the school years into adulthood. The development of math skills is crucial for academic achievement and lifelong success, yet numerous students struggle with learning math[1]. Within the classroom context, mathematics anxiety emerges as a significant barrier to effective math learning and performance. Researchers have identified various factors contributing to mathematics anxiety, including physiological differences[2] and biological dispositions[3]. However, the prevailing view is that mathematics anxiety is largely a learned experience within the classroom environment[4].

Mathematics anxiety is characterized by feelings of fear, tension, or dread when confronted with math tasks or even the prospect of math[5]. It is one of the most common academic anxieties, with studies indicating that approximately 30% of 15-year-old students report feeling nervous or helpless when dealing with math tasks[6]. The detrimental effects of mathematics anxiety on academic performance are well-documented. Students experiencing mathematics anxiety are more likely to underperform on math assessments, miss classes, and avoid math assignments[2]. This avoidance stems from the cognitive load required to manage anxiety, which detracts from the cognitive resources available for problem-solving[7]. In addition, avoidance behaviors limit opportunities for skill development and practice, further impairing understanding and performance[2].

This study examined the contribution of negative classroom environment to mathematics anxiety among high school students. Learning environments involve various classroom components, including physical settings, pedagogical strategies, classroom structures, and interpersonal dynamics[8]. The relation between these elements and individual characteristics has been extensively studied through ecological systems[9] and field theory[10], with a growing emphasis on constructivist theory, which highlights the individual's perception of their environment[11]. The learning environment significantly influences both emotional experiences during learning and achievement outcomes[12,13]. Mathematics anxiety tends to become more pronounced in late elementary school, when mathematical concepts become more complex, making the teacher's role even more critical[14].

Research suggests that mathematics anxiety is often a learned response to negative classroom experiences. For instance, a child being called to solve an equation at the chalkboard and failing might feel embarrassed and develop mathematics anxiety[4]. The teacher's role is essential in shaping these emotional responses; students learn best in environments where teachers minimize exposure to negative experiences that could evoke anxiety or fear[15,16]. With a supportive and encouraging classroom environment, teachers can help mitigate mathematics anxiety and support positive math learning experiences. Thus, addressing mathematics anxiety requires a comprehensive approach that considers the relation between individual differences, classroom dynamics, and the broader learning environment.

2. Literature review

Mathematics anxiety is a prevalent psychological challenge that significantly influences students' attitudes toward mathematics and their academic performance[17]. It is characterized by feelings of tension, fear, and apprehension when faced with math-related tasks and situations and has been associated with negative educational outcomes across various stages of schooling[18,19]. For instance, high levels of mathematics anxiety are linked with lower math achievement, reduced interest in science, technology, engineering, and mathematics (STEM) fields, and decreased likelihood of pursuing advanced math courses[20,21]. This anxiety is not confined to performance situations but can also extend to learning environments, affecting how students interact with and perceive math content[22].

Mathematics anxiety is often multidimensional, encompassing various components such as worry—negative self-evaluations and cognitive doubts about math abilities—and emotionality—physical responses such as sweating or a racing heart when faced with math tasks[23,24]. These components reflect both the cognitive and emotional aspects of anxiety, influencing students' experiences in different math contexts, from problem-solving to test-taking[25]. Mathematics anxiety is not only a cognitive or emotional state but also has significant implications for students' motivational orientations. Research indicates that mathematics anxiety is associated with performance-avoidance goal orientations—goals that focus on avoiding failure rather than mastering content—which can hinder content mastery and learning[26,27]. These goal orientations are linked to reduced content engagement and poorer math achievement over time.

This paper explored the role of teacher-student relationships as a potential factor in mathematics anxiety among students. The teacher-student relationship constitutes a fundamental and reciprocal interpersonal connection that occurs within both proximal and distal systems, involving direct interactions in the classroom and broader contextual influences such as the classroom environment and school culture[28,29]. For optimal student development, both these systems must be considered, as they collectively shape the quality of the teaching and learning experience. Research grounded in attachment theory underscores that positive teacher-student relationships are characterized by high warmth, trust, and minimal negativity, which are critical for fostering a sense of emotional security among students[30-31]. Emotional security is particularly essential, as it underpins the development of a supportive classroom environment where students feel safe to participate actively and engage in learning processes[28]. Such environments promote motivation and engagement, which are key drivers of academic achievement[32-34]. The quality of the teacher-student relationship, therefore, serves as a critical determinant of student learning outcomes[35].

The teacher-student relationship is not only integral to the emotional and social development of students but also has a direct impact on their academic performance. Several studies have established a positive association between supportive teacher-student relationships and improved student outcomes in mathematics, reading, and other academic subjects[36-39]. These relationships are particularly influential in shaping students' motivational beliefs, which, in turn, impact their learning behaviors and perceptions[40-42]. For instance, when students perceive their teachers as supportive, they are more likely to develop a positive self-concept and higher self-efficacy, which are important indicators of motivation and achievement[43,44].

Further, the impact of teacher-student relationships extends beyond immediate academic performance to include long-term educational aspirations and attitudes towards learning. Negative perceptions, such as mathematics anxiety, are correlated with poorer academic outcomes[45]. Conversely, a positive relationship with a teacher can mitigate these anxieties and enhance students' confidence and motivation, thereby improving learning outcomes [34]; McCormick & O'Connor,[46]. Teacher-student relationship is a crucial element in the educational landscape that significantly influences students' emotional security, motivation, engagement, and ultimately, their academic success.

More importantly, classroom management shapes students' experiences in the teaching and learning process, extending beyond the mere mechanics of teaching and learning interactions to encourage an environment where students can engage positively with the material and one another[47]. Effective classroom management is integral to maximizing learning opportunities by creating a healthy, productive, and conducive environment. Experts argued on the importance of nurturing such environments and ensuring that appropriate learning opportunities are available, which in turn reflects a comprehensive approach to classroom management[48]. Classroom management as the strategic use of techniques to establish and maintain an environment free from behavioral issues, wherein classroom management and education should

not be viewed as separate entities but rather as interconnected variables that simultaneously influence the creation of an optimal classroom climate[49].

The teacher's management style directly influences classroom dynamics and student interactions, which are critical for achieving educational goals[50]. Interactive management, a systemic approach that addresses situational, cognitive, and pluralistic aspects of complexity, enhances learning and stakeholder interaction by clarifying, organizing, and interpreting ideas[51,52]. Classroom management should reflect processes and interactions, including monitoring class activities, managing behaviors, and considering socio-cultural and psychological aspects[50]. Effective classroom management ensures a balanced climate, encouraging positive student engagement and a favorable self-image, thereby supporting both immediate classroom management needs and long-term student outcomes[51,52].

3. Objectives

This paper explored the experiences of high school students who face mathematics anxiety. This study analyzed how do teachers encouraged positive teacher-student relations reducing students' fear in mathematics. Below are the specific objectives in this study.

(a) Determine how teacher behavior reduce the fear of students to numbers.

(b) Determine how instructional strategies played in in converting fear into welcoming numbers in learning.

4. Methods

4.1. Research design

This paper explored how fear of numbers become a phenomenon among students learning mathematics. This study also explored how teacher modelling and instructional intervention help students in alleviating their fear of numbers. Exploratory studies aim to gain an initial understanding of phenomena that are not well-documented or lack substantial prior investigation, making them particularly relevant in addressing emerging or complex issues[53,54]. These studies focus on uncovering patterns, generating insights, and identifying key themes rather than testing hypotheses or confirming existing theories, often serving as a precursor to more structured research[55,56]. Employing flexible and predominantly qualitative methods such as interviews, observations, and open-ended surveys, exploratory studies enable researchers to delve deeply into social or psychological phenomena, capturing their intricate nature[57,58]. They facilitate the identification of general patterns and provide the groundwork for hypothesis formulation, which can guide future rigorous investigations[59,60]. While sometimes critiqued for a perceived lack of scientific rigor, their efficiency in offering preliminary data and novel perspectives is widely acknowledged[54]. In social science, these studies involve systematic and thoughtful planning to ensure the thorough exploration of questions arising from phenomena, ultimately contributing to the broader understanding of underexplored areas[61,62]. With emphasis on flexibility and participant engagement, exploratory designs not only reveal the full scope of a phenomenon but also allow for active contributions from study participants, encouraging the generation of new knowledge in areas that remain largely uncharted[62,63].

4.2. Participants and sampling

In exploratory research, sampling is often characterized by small, carefully selected participant groups, as the aim is to achieve depth of understanding rather than broad generalization[64]. Researchers frequently employ purposive sampling, a non-probability approach in which participants are deliberately chosen based on specific attributes or experiences directly relevant to the study purpose[17]. This method allows researchers

to focus on individuals who can provide meaningful perspectives, ensuring that the data gathered is relevant and aligned with the research questions[65]. Unlike studies requiring large sample sizes for statistical inference, exploratory designs prioritize flexibility and relevance over numerical representation, as the primary intent is to explore key variables and uncover patterns or themes rather than draw universal conclusions[55,66]. In sampling, online purposive sampling[67] through open-ended questions, was carried out to gather preliminary data from the participants. Preliminary data involved the demographics of the participants and their reflections about their personal anxiety to numbers. There were three major participant characteristics used in sampling: (1) enrolled in academic year 2024-2025, (2) should had passing grade in mathematics (>75%), and (3) had experienced anxiety in mathematics. **Table 1** presents the summary of the participants' characteristics sampled for interviews. Through purposive sampling, researchers ensure that participants possess characteristics or experiences critical to addressing the study's questions, maximizing the potential for meaningful discoveries[68,58].

Table 1. Characteristics of sampled participants.

Name	Age	Sex	Grade Level	Math Grade	Anxiety in Mathematics
Alex	13	Male	8	78	Feels nervous during exams and avoids asking questions in class.
Bella	14	Female	9	80	Struggles with solving word problems and often feels overwhelmed.
Chris	15	Male	10	76	Avoids participating in class discussions about math.
Diana	16	Female	11	82	Finds it difficult to focus during math lessons and feels stressed.
Ethan	14	Male	8	79	Panics when encountering unfamiliar problems.
Fiona	13	Female	8	77	Often procrastinates math homework due to fear of failure.
George	17	Male	12	85	Feels anxious when solving problems on the board in front of classmates.
Hannah	15	Female	10	81	Experiences self-doubt, believing she is not good at math.
Ivan	16	Male	11	75	Often freezes during timed math quizzes.
Jenna	14	Female	9	78	Avoids taking advanced math courses due to lack of confidence.
Kyle	12	Male	8	80	Struggles with fractions and feels frustrated during practice.
Lily	13	Female	8	79	Feels embarrassed to ask for help in math class.
Michael	18	Male	12	84	Experiences stress when tackling complex algebra problems.
Natalie	16	Female	11	83	Finds group work in math intimidating and prefers working alone.
Owen	17	Male	12	86	Feels uneasy about public speaking during math presentations.
Paige	15	Female	10	79	Gets anxious about making mistakes on math assignments.

4.3. Instrumentation

Developing a semi-structured interview guide in qualitative research involves a strategic and systematic process aimed at eliciting comprehensive, meaningful responses from participants while aligning with the study's objectives. This type of guide combines structure with flexibility, enabling researchers to direct the conversation toward essential themes while allowing participants to freely share their narratives and perspectives[69,70]. The process begins by identifying the prerequisites, including a thorough understanding of the research context, objectives, and any existing knowledge that informs the design of the interview questions[71]. Initial questions are then crafted to stimulate discussion and uncover relevant insights, focusing on clarity and openness to avoid ambiguity or misinterpretation. Pilot testing the guide is a crucial step to refine these questions, ensuring they are effective in prompting detailed and unbiased responses[72,73]. Based on pilot feedback, final adjustments are made to create a well-balanced framework that facilitates natural

dialogue while systematically addressing the key areas of interest. Semi-structured interviews, as guided by this approach, provide a dynamic platform for exploring ideas, offering flexibility for interviewers to adapt to participants' responses by probing deeper or clarifying answers as needed[74,75]. This adaptability not only enhances the richness of the data collected but also minimizes biases stemming from social desirability or conformity, reflecting authentic and insightful exchanges[76]. The interview guide ensures that all critical topics are covered while creating space for participants to express themselves fully, thereby contributing to a deeper understanding of the phenomena under investigation[77,78]. **Table 2** presents the final interview guide after pilot testing and expert validation.

Table 2. Semi-structured interview guide questions.

Objectives	Questions
Determine how teacher behavior reduce the fear of students to numbers.	a. How can teachers help students overcome their fear of numbers? b. What actions or behaviors of teachers make students more afraid of numbers? c. How should teachers act during lessons to support students who dislike math or numbers-related subjects?
Determine how instructional strategies played in in converting fear into welcoming numbers in learning.	a. Can teaching activities help reduce your fear of numbers? Please explain. b. What activities helped you become more comfortable with numbers? c. What teaching strategies do you prefer to feel less anxious in math or numbers-related courses? Please explain.

4.4. Data gathering procedure

Interviews are particularly effective for capturing personal narratives and providing a platform for individuals to share their experiences and viewpoints, making them a powerful tool in qualitative research[79]. The semi-structured format used in this study allowed for an organic conversation, which helped elicit rich and detailed responses from participants, reflecting their lived experiences. This flexibility enables researchers to explore topics deeply, adapting follow-up questions to participants' responses, which is essential for understanding complex phenomena like mathematics anxiety[80,81]. To ensure a systematic and effective interview process, the study followed established qualitative research protocols. This included clearly defining the research objectives, selecting appropriate participants, and explaining the study's purpose, along with ensuring confidentiality and proper data use[82,83]. During the interviews, thematic questions were used to guide the discussion, encouraging participants to elaborate on their experiences and allowing them to provide detailed accounts. This conversational style, which encourage a natural and informal atmosphere, was key in eliciting meaningful responses[84,80]. To mitigate language barriers and enhance comfort, participants were encouraged to express themselves in their preferred languages, ensuring their responses were captured accurately and in context[85]. Audio recordings, with participants' consent, were utilized to ensure accurate data capture, while preliminary notes helped organize key points for later analysis[86].

4.5. Data analysis

Thematic analysis is a qualitative method that allows researchers to systematically identify and interpret patterns of meaning within narrative data, particularly from one-on-one interviews[87]. It is especially useful for exploring shared experiences and the deeper meanings embedded in participants' narratives, making it an effective tool for understanding the richness of lived experiences[88]. The flexibility of thematic analysis enables it to be well-suited for exploratory research, where themes can emerge organically as researchers engage with the data, reflecting with the participants' perspectives[57,89]. The coding process in thematic analysis involves a layered approach—starting with descriptive codes and advancing towards more interpretative analyses—allowing researchers to gradually build up insights as they move through the data[90,91]. Reflexive thematic analysis emphasizes the active role of the researcher in the interpretation

process, recognizing that the researcher's own values, experiences, and assumptions can shape the analysis[92]. This method acknowledges the subjective nature of coding, requiring researchers to reflect on how their perspectives may influence the findings[93]. To ensure minimal bias, the study adopted an inductive approach to thematic analysis. This method allows themes and patterns to emerge directly from the data itself, without being constrained by preconceived theories or assumptions, ensuring that the findings are grounded in the actual content of the data[94]. The study adhered to the six-phase framework of reflexive thematic analysis as outlined by Braun and Clarke[95], which supports methodological rigor while allowing for flexibility. This iterative process involves continuously revisiting and refining themes as new insights and patterns emerge, facilitating a deeper understanding of the data and its underlying meanings[88]. The inductive nature of thematic analysis in this study ensures that the codes and themes are directly derived from the data[96], aligning with the content and context of the participants' experiences. This approach not only allows for the emergence of central themes but also ensures that the study maintains an exploratory focus, capturing the richness and diversity of participants' narratives[88]. **Figure 1** presents the six phases of reflexive thematic analysis.

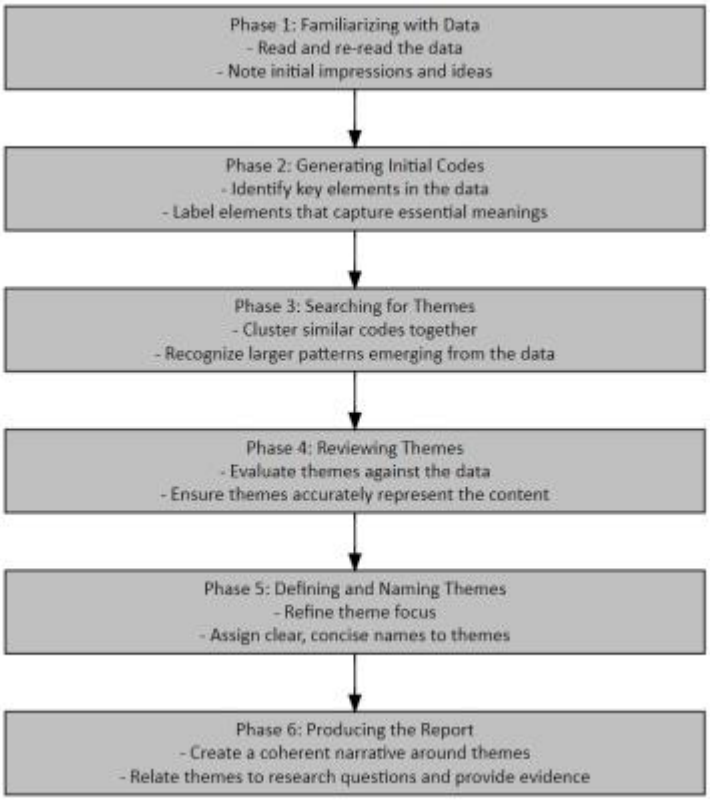

Figure 1. Workflow of data analysis process.

5. Results

Objective 1: Determine how teacher behavior reduce the fear of students to numbers.

Empathetic teacher behavior was key to easing students' anxiety about numbers. When teachers showed genuine understanding and create an inclusive environment, students feel safe to ask questions and make mistakes without fear of embarrassment. This kind of support built students' confidence and encourages engagement with the material. Similarly, passionate teachers who express confidence and enthusiasm about the subject can make a significant difference in how students perceive math. Their engagement helped demystify the subject and reduces anxiety. When teachers share their own experiences of struggle and show

persistence, it normalized challenges and encouraged students to stay motivated. This approach encouraged supportive and collaborative learning environment, where students feel less alone in their difficulties.

Theme 1: Empathy

Empathy emerged as a critical theme in how students experienced their relationship with teachers in mathematics classes. The students described how *empathetic behaviors* from teachers had a profound impact on their emotional engagement and willingness to participate in class. They highlighted the importance of a supportive learning environment where they felt safe to make *mistakes* and ask *questions* without fear of *judgment*.

> "Having a teacher who is not only knowledgeable but also empathetic can make all the difference. They create an environment where I feel safe making mistakes and asking questions, which really helps with my fear of numbers."

For instance, one student noted that their teacher's approach of not criticizing *mistakes* but rather guiding them through the process allowed them to focus more on learning. This non-judgmental attitude helped reduce *anxiety* and encouraged them to engage more deeply with the material.

> "My teacher made it clear that no one would be judged for asking questions, no matter how simple they seemed. That made me feel like I was part of the learning process instead of feeling left out."

> "When I made a mistake, my teacher never pointed it out negatively. Instead, they said, 'Let's look at what you did and see how we can fix it,' which really helped me stay focused."

Students appreciated when teachers took the time to acknowledge the challenges they faced with *math*. This *acknowledgment* made students feel validated in their *struggles* and less isolated in their experiences. It encouraged a sense of *community* within the classroom, where students felt understood and less hesitant to seek help. The idea that no *question* was too simple or unnecessary was particularly empowering for students, as it made them feel like active participants in their *learning journey* rather than passive recipients. They valued teachers who believed in their *ability* to succeed, even when they encountered difficulties, which boosted their *confidence* and willingness to attempt problem-solving tasks.

> "A teacher who believes in my ability, even when I struggle, boosts my confidence and makes me more willing to tackle problems."

> "I really appreciated when my teacher acknowledged how tough math can be for some of us. It made me feel like I wasn't the only one who found it difficult. The teacher didn't judge me when I struggled. I felt more comfortable asking questions."

The encouragement to take *risks* and learn from *mistakes* was a significant factor in developing a positive learning experience. Teachers who viewed *mistakes* as opportunities for *growth* were instrumental in helping students develop a more resilient attitude towards *math*. This supportive *feedback loop* enabled students to view challenges as part of the *learning process* rather than barriers to their *success*.

There were also students who encountered a more *negative* and *unsupportive* environment. For instance, one student described how the professor would frequently highlight *mistakes* as *examples of what not to do*, using them as an opportunity to *point out errors* rather than addressing them constructively. This approach left the student feeling *punished* for simple *errors* and heightened their *self-consciousness* about their *math*

ability. It suggested to the student that *failure* was something to be *ashamed* of, discouraging them from engaging more actively with the material.

> "Every time I got something wrong, the professor would use my mistake as an example of what not to do. I felt like I was being punished for making simple errors, which made me very self-conscious about math after that."

> "Whenever I made a mistake in class, the professor would call me out in front of everyone, making me feel embarrassed and reinforcing my fear of making mistakes."

Another student reported that the professor *did not seem to care* about their *stress* or *difficulty with the content*. When they expressed confusion, the professor's *response* was dismissive, telling them they should already *know the material*. This created a *barrier* to *learning* and contributed to a *sense of failure*. The *absence of support* made it difficult for the student to view *math* as an *attainable goal*, reinforcing the idea that they could *never succeed* in the subject.

> "The professor never seemed to care about how stressful it was for us. When I said I didn't understand, they just said, 'You should already know this.' It made me feel like math was something I could never succeed at."

> "The worst part was not feeling heard. Every time I expressed how difficult the material was, I got no emotional support or understanding. It felt like I was the only one in the class who was struggling, and I didn't want to burden anyone by asking for help."

While students who experienced a supportive environment valued teachers who believed in their potential and provided constructive feedback, those in a negative environment felt overlooked and unmotivated. The contrasting experiences underscore the significant role of empathy in shaping students' attitudes towards learning mathematics. In the supportive environment, students were more likely to take risks, learn from their mistakes, and view challenges as part of the learning process. In contrast, the unsupportive environment discouraged engagement and reinforced a sense of failure, making it harder for students to succeed.

Theme 2: Passion

Students emphasized how a teacher's enthusiasm for the subject matter could create an engaging and supportive classroom atmosphere. For many students, a teacher who was passionate about the material was seen as a role model, making the learning experience more relatable and less intimidating. *Passionate* teachers were perceived as more approachable and capable, which encouraged students to actively participate in class and approach challenging problems with more confidence.

> "When a teacher is passionate about the subject and shows confidence in working through numbers, it can be contagious. I tend to feel more comfortable when I see my teacher engaging with the material confidently."

One key aspect of this theme was the role of vulnerability in building rapport and trust between teachers and students. Students noted that a teacher who acknowledged their own struggles with the material and shared their journey of overcoming difficulties helped them feel more connected and understood. This transparency made learning numbers seem less daunting, as it normalized the challenges associated with mastering mathematical concepts. *Demonstrating vulnerability* allowed students to see that difficulties with

numbers were a shared experience, rather than an indicator of personal failure, encouraging a sense of solidarity and resilience in the face of challenges.

> "If a teacher demonstrates that they, too, struggle at times but are able to work through challenges, it shows me that it's normal to have difficulties with numbers. It helps me feel less alone in my struggles and more motivated to continue."

The *passionate* teachers were also seen as encouraging role models who believed in students' abilities, even when faced with difficulties. This belief in students' potential acted as a catalyst for motivation, making it easier for students to persist through challenges. They felt supported in their learning journey, knowing that their struggles were acknowledged and that there was a pathway to success through persistence and effort. *Believing in students' abilities* helped diminish feelings of insecurity and fear of failure, motivating students to actively engage in problem-solving and seek help when needed.

Objective 2: Determine how instructional strategies played in in converting fear into welcoming numbers in learning.

This study observed three major instructional strategies that could help students alleviate their fear of numbers—the simplification, collaboration, and interactive learning.

Simplification focused on how breaking down complex mathematical concepts into more manageable steps can significantly reduce anxiety and increase understanding. Students appreciate when instructors use real-world examples, step-by-step approaches, and simple terms to explain difficult topics.

Collaboration examined the role of group work in enhancing engagement and confidence in math learning. Students find that working with peers helps them ask questions, receive feedback, and discuss different approaches to problem-solving. Group activities not only provide support and validation but also expose students to multiple strategies for tackling mathematical challenges.

Interactive Learning looks at the impact of hands-on activities and real-world applications in math education. Engaging students through projects, real-life scenarios, and the use of online tools makes math more relevant and less abstract. By integrating practical applications, such as calculating costs or simulating scenarios through online tools or video games, students see the value of math beyond the classroom.

Theme 1: Simplification

Simplification emerged as a significant factor in improving students' engagement with mathematics by making complex content more accessible. This approach involved breaking down mathematical concepts into more digestible parts, making them easier to understand and less intimidating.

Students expressed that having complex topics divided into simpler components made the material less overwhelming. For many, this method was particularly helpful because it allowed them to focus on one idea at a time without feeling the pressure to understand everything at once. When teachers *broke down complex topics*, it was as if they were providing a roadmap for learning, guiding students step-by-step through the process. This approach helped reduce the cognitive load associated with learning math and made the subject feel more accessible. Students appreciated when teachers *explained things in stages*, ensuring that each step was clear before moving on to the next.

> "A teacher who can break down complex topics into digestible pieces and explain concepts in different ways can really help students like me who find numbers overwhelming. When I understand the logic behind the numbers, the fear tends to lessen."

When *problems were broken down* into clear, sequential steps and *explained slowly*, students could engage more comfortably with the content. This paced approach allowed them to absorb one concept at a time, reducing the sense of being overwhelmed. For instance, when instructors *went over problems slowly*, it gave students the opportunity to process each part before moving forward. This pacing *enhanced comprehension* and helped students feel more at ease with the material. It was important to many that the *teacher took the time to explain each step thoroughly*, making sure there was no rush and that they had a chance to ask questions and get clarifications.

> "The teacher took the time to break down each step in a problem, and that made it easier to follow. I liked when the teacher used simple terms to explain difficult concepts."

> "What helped me the most was when my instructor broke complex topics into smaller, more manageable steps. Starting with simple concepts and gradually building up to more advanced topics made the learning process less overwhelming. It helped me develop confidence in my ability to handle numbers."

Instructional strategies that involved *step-by-step explanations* were particularly appreciated. Students described how this method provided a *structured path* for solving problems, which made the material easier to engage with. When teachers *showed the exact steps to follow* and *talked about why each step was necessary*, it helped students understand the rationale behind each action. This *checklist* approach allowed students to *break down problems* into manageable parts, making the entire process more understandable and less overwhelming. They felt more confident in their ability to tackle complex problems because they knew they could always refer back to the process. This *clear sequencing* of steps was instrumental in preventing students from feeling like they had to keep everything in their heads at once. Instead, they could focus on mastering one part before moving on to the next, which *made learning math less stressful*.

> "I liked how the teacher showed us the exact steps to follow when solving problems. It felt like a checklist I could use whenever I was stuck. When we solved problems step-by-step and talked about why we did each part, it made the whole process clearer."

> "I have noticed that when a teacher explains things step-by-step, I start to see math as something less abstract. It doesn't feel as intimidating when I can make sense of it in a way that connects to my daily life."

> "When a problem is split into clear steps, I don't feel like I have to keep everything in my head all at once. It feels more manageable, and I can process each part before moving to the next."

> "When the instructor goes over problems slowly and explains every step, I feel more confident and less anxious. I can always refer back to the process rather than feeling I need to memorize everything at once."

Theme 2: Collaboration

Collaboration highlighted the importance of group activities in enhancing students' engagement and comfort with mathematics. It underscored how collaborative learning environments facilitated deeper understanding, supported peer interaction, and reduced anxiety associated with problem-solving. This theme emerged as a counterbalance to traditional solo work, promoting a more communal approach to learning that emphasized discussion, sharing of strategies, and mutual support.

Students described how they used to feel nervous about solving math problems *in front of the class*. However, when engaged in *group activities*, they found themselves more at ease. This transition was primarily due to the *support* and *non-judgmental* atmosphere developed within the group. In these settings, students were encouraged to *ask questions* without fear of being ridiculed or singled out for mistakes. This collaborative approach *helped them build confidence*, as they could tap into the collective knowledge of their peers and gain different perspectives on problem-solving strategies. The supportive environment *reduced anxiety*, making it easier for students to *participate actively* and contribute to discussions. Peers' willingness to share their ideas *contributed to a sense of community* that was both encouraging and validating.

> "I used to get nervous when I was asked to solve problems in front of the class, but group activities allowed me to ask questions and receive support. My peers were kind, and I didn't feel judged. This helped me build my confidence."

> "Being able to talk through the problem with someone else helped me engage more with the content. It wasn't just me sitting in silence, trying to figure everything out alone. My peers' explanations often made things clearer."

Rather than being isolated in their attempts to understand the material, students found that *talking through problems* with others helped them *engage more deeply* with the content. They appreciated that collaboration was not just about arriving at a *correct answer*, but rather about *discussing different methods* and considering multiple perspectives. This *shared dialogue* allowed them to *learn from each other*, broadening their understanding and enhancing their problem-solving skills. By working together, students began to *see math as a tool for thinking* and *problem-solving*, rather than a set of isolated concepts to memorize. They came to value the *diversity of approaches* within the group, understanding that *there are multiple ways to tackle problems*. This realization *increased their comfort with numbers* and allowed them to *see math as a dynamic and adaptable subject*.

> "Group activities where we had to solve math problems together made a huge difference for me. It wasn't just about memorizing formulas; it was about discussing how to approach problems and realizing that there are multiple ways to solve them. It made me more comfortable with the idea of numbers as tools for thinking and problem-solving."

> "Working in groups allowed us to bounce ideas off each other. Instead of just following a formula, we discussed different methods of solving a problem and weighed the pros and cons of each approach."

They learned that there was no one-size-fits-all solution to problems, and this *flexibility encourage creativity* in thinking. Working with peers *encouraged experimentation*, which was *helpful in developing a deeper understanding* of concepts. The discussions in these groups *stimulated critical thinking*, as students had to *justify their reasoning* and *consider the pros and cons* of different approaches. This process *helped them develop a more nuanced view* of problem-solving, enhancing their ability to *navigate complex scenarios* independently.

> "When we were encouraged to solve problems in groups or on our own during class, I felt more confident. I stopped fearing numbers because I was actively involved in the process and realized I could figure them out with practice."

Theme 3: Interactive Learning

Interactive Learning highlighted the importance of engaging, practical experiences and the use of digital tools to make math more relevant and less abstract for students. It underscored a shift from passive to active learning, where students interacted directly with content and technology to explore and apply mathematical concepts.

Students valued projects that allowed them to *apply math to real-world problems*. For instance, working on a project *calculating the cost of a new public transportation system* made math feel like a tool for problem-solving, not just a set of formulas to memorize. This *real-world application* showed them that their mathematical skills could have a tangible impact on society. *Hands-on activities* like these *engaged students* and *motivated them* to see math as a practical discipline.

> "I loved it when we worked on a project where we had to calculate the cost of a new public transportation system. It wasn't just about getting the right numbers—it felt like I was actually solving something that could affect people's lives."

Another aspect of *interactive learning* was linking math to other disciplines. Students appreciated teachers showing how math intersected with economics or biology. This *interdisciplinary approach* provided a broader context for understanding math and *demonstrated its relevance* across different fields. It helped students see the bigger picture of how math connected with real-world applications.

> "I find it easier to understand equations when the teacher shows how they're used in real-life situations, like in economics or biology. It makes the math feel more relevant."

The use of *online tools* was another key feature of *interactive learning*. Students enjoyed *using digital platforms* that allowed them to *interact with problems*, such as dragging variables to see the effects of changes. This interactive method engaged students more deeply with the material. It made math feel more dynamic and less like a static set of rules to memorize. *Self-paced* tools *enabled students* to *learn at their own speed*, revisit challenging areas, and *test their understanding* in a more personalized way.

> "I'm happy to know when online tools allow me to interact with problems, like dragging variables around to see how changes affect the outcome. It makes math feel less dry and more like a puzzle I can figure out."

> "I love when professors recommend online tools or resources. It's comforting knowing I can practice on my own time and learn at my own speed."

Technology and gamified learning also played a significant role in *interactive learning*. For example, using video games to teach probability made math more enjoyable and relevant. Games that involved prediction and decision-making showed students the real-world applications of math in a way that was engaging. This approach helped demystify math, making it feel more like a dynamic, interactive subject rather than a set of abstract concepts.

> "I never really liked math until we used video games to learn about probability. It was fun to see how math helps predict what will happen in a game! When we used coding to create simple games, I realized that math was behind all the tech I enjoy. It made me feel like I could create things, too."

6. Discussion

Mathematics anxiety significantly affects performance in mathematical tasks. Individuals with high trait-level mathematics anxiety, a long-term predisposition to fear math, tend to experience state anxiety, an

acute in-the-moment emotional reaction when dealing with math. This acute anxiety interferes with working memory, a cognitive resource critical for solving complex mathematical problems[97-99]. While reduced working memory and diminished goal-directed processing have been frequently associated with poor performance among individuals with mathematics anxiety, the extent to which state anxiety contributes to this underperformance remains inadequately explored[100,101]. Although existing research has investigated the relationships between trait-level mathematics anxiety, state anxiety, and mathematics performance, there is limited empirical evidence quantifying the direct impact of in-the-moment anxiety on performance outcomes[102,103]. This gap in understanding is crucial; if state anxiety serves as a predominant factor in undermining performance, intervention strategies should concentrate on mitigating these immediate emotional responses[104,105].

Emotion regulation, involving strategies that individuals employ to manage the type, intensity, and duration of their emotional experiences, is likely to have significant help in diminishing mathematics anxiety[106]. Numerous interventions designed to address mathematics anxiety incorporate emotion regulation techniques, aiming to equip individuals with the skills needed to manage state anxiety effectively. Empirical studies indicate that such strategies can improve test performance, which enables individuals with mathematics anxiety to better manage their emotional responses and improve their problem-solving capabilities[107-110]. Further investigation is needed to ascertain whether intervention efforts should primarily target immediate anxiety reduction or focus on more comprehensive strategies. Concurrently, the adoption of emotion regulation techniques presents a promising approach to addressing the challenges associated with mathematics anxiety[111-113,110].

This paper observed that having social-emotional interaction between students and teachers helped lessen students' mathematics anxiety. The findings of this study strongly correlate with broader literature on social-emotional learning, particularly regarding the critical role of social interaction and emotional regulation in shaping educational practices. Emotional competence is deeply intertwined with culturally normed ideals of selfhood[114-117]. These ideals emphasize not only the regulation of negative emotions but also the ways in which emotional regulation practices reflect societal values and objectives. In the context of social-emotional learning, emotional regulation emerges as a central skill, often focused on mitigating disruptive behaviors and developing positive emotional states[118,119].

Positive emotional interactions between teachers and students create a supportive and engaging learning environment that develop students' motivation, enhances their confidence, and encourages active participation in learning activities. High-quality teacher-student relationships could address mathematics anxiety and enhancing math performance among students[120]. While conflict within these relationships can heighten anxiety levels, having a warm, supportive, and trusting environment significantly reduces mathematics anxiety[121]. In this paper, showing empathy towards students and manifesting passion in teaching could alleviate students' fear of mathematics. For example, one student noted that *"I really appreciated when my teacher acknowledged how tough math can be for some of us. It made me feel like I wasn't the only one who found it difficult."* In contrast, when their teacher shows strictness like when *"…[using] mistake as an example of what not to do,"* students feel being punished for their minor errors which also makes them self-conscious or afraid to answer questions. This validation not only reassures students but also normalizes their struggles, helping them to overcome feelings of inadequacy. On the other hand, excessively strict approaches—such as public criticism of mistakes—can heighten students' fear of failure, discourage active participation, and intensify anxiety. Semeraro et al.[121] explained that positive relationships provide students with the emotional tools needed to cope with their mathematics anxiety effectively, leading to improved academic outcomes. In this paper, positive relationship can be in a form of

affirmation, constructive feedback, providing correct examples, checking/verification in which students feel that *"no one would be judged for asking questions, no matter how simple they seemed."*

Further, positive math achievement is often facilitated through the reduction of mathematics anxiety, highlighting the mediating role of the teacher-student relation. Teacher self-efficacy also contributes indirectly to students' mathematics anxiety and achievement through its influence on teaching attitudes, practices, and behaviors[122]. Teacher efficacy is described as the teacher's perception of their ability to achieve desired results in student participation and learning, including with students who may be challenging or lack motivation[123]. In this study, math teachers manifested teaching efficacy, especially in times when they encounter challenges in teaching students. One student revealed that *"When a teacher is passionate about the subject and shows confidence in working through numbers, it can be contagious. I tend to feel more comfortable when I see my teacher engaging with the material confidently."* Early studies indicated that teachers' self-efficacy can be correlated to their students' self-efficacy in learning[124-126]. This paper assessed the impact of teacher passion and efficacy on student comfort and anxiety levels in mathematics. Particularly, one student said that *"If a teacher demonstrates that they, too, struggle at times but are able to work through challenges, it shows me that it's normal to have difficulties with numbers."* This sentiment has broader implications of teacher efficacy—when teachers humanize the learning process by openly addressing their own struggles or modeling problem-solving techniques, they dismantle the stigma surrounding failure, reframing it as a natural and valuable component of learning. Consequently, this process helps alleviate mathematics anxiety as students feel *"less alone in [their] struggles and more motivated to continue [learning]."*

There were instances wherein teachers who apply collaboration, interactive learning and simplification techniques in teaching mathematics enabled students feel positive about mathematics learning, reducing their feal of failures. Alishahi, Panahi and Samadi[49] found that interactive management not only addresses immediate behavioral challenges but also enhances students' ability to adapt academically within the learning environment. This has direct interaction with students' academic achievement, motivation, environmental satisfaction, and relaxation in defining academic adjustment[127]. Apparently, positive classroom interaction, like affirmation, constructive feedback, and corrections, encouraged students to participate in class and feel less anxious in learning mathematics. Kayıkçı[128] found a relationship between teachers' classroom management skills and students' disciplinary behavior, suggesting that effective management supports students' ability to regulate themselves academically and socially. This paper explained that with effective management, students *"...stopped fearing numbers because I was actively involved in the process and realized I could figure them out with practice."* For example, when teachers simplify complex math topics into step-by-step process, it helps their students feel at ease with learning while encouraging them to explore new ideas or solve problems on their own. This learning process also appeared in positive teacher-student relationship as students *"can always refer back to the process rather than feeling [they] need to memorize everything at once."* As a result, they are better equipped to reflect on their thinking, evaluate their problem-solving strategies, and adjust their approaches as needed. This shift from a mere memorization-focused strategy to a more flexible, reflective approach aligns well with contemporary educational goals that aim to develop critical thinking and independent learning skills. Whenever there is low mathematics anxiety among students, they feel less concerned about making mistakes which encourages them to participate in self-directed learning. They became more competent in adapting to different sources of information for learning, especially through online tools and resources.

Consequently, a positive teacher-student relationship enables students to engage deeply with their own learning processes and develops an environment where they can reflect on and articulate their thoughts and

realizations. This kind of relationship encourages self-directed learning and helps students take ownership of their educational journey. When students feel comfortable and supported by their teachers, they are more likely to engage in introspection and self-assessment, which are critical components of metacognitive skills. High-quality interactions characterized by empathy and constructive feedback help students feel understood and valued, which potentially lowers their fear of failure. Integrating emotion regulation strategies within this relationship can further aid in managing immediate anxiety, helping students remain calm and focused during math tasks. When students feel less anxious, they are more likely to engage deeply with the material and develop metacognitive skills essential for problem-solving and independent learning.

7. Conclusion

Mathematics anxiety significantly affects individuals' performance in mathematical tasks, with a strong correlation between high trait-level mathematics anxiety and acute state anxiety when dealing with math problems. Despite the established connection between trait and state anxiety and poor math performance, the specific role of state anxiety in underperformance requires further exploration. This study found out that when teachers demonstrated empathy—by valuing students' efforts, normalizing mistakes, and encouraging a non-judgmental atmosphere—students felt safer to participate, make mistakes, and ask questions. This supportive environment not only reduced anxiety but also encouraged active participation and a deeper connection with the subject matter. Further, passionate teachers who shared their own struggles and persistence with math could be particularly influential. This role model behavior was critical in normalizing difficulties with numbers, encouraging resilience, and building a supportive classroom community. In terms of instructional strategies, simplification and collaboration were effective methods for converting fear into welcoming learning experiences. Simplification involved breaking down complex concepts into manageable steps, reducing cognitive load and enhancing understanding. Collaboration created a communal learning environment where students could interact, share strategies, and receive supportive feedback, reducing feelings of isolation. Interactive learning, which included real-world applications and hands-on activities, further enriched the experience by making math more engaging and relevant, enhancing motivation and enthusiasm for the subject.

Given these findings, it is essential to address mathematics anxiety through targeted interventions that aim to reduce both trait and state anxiety. Schools and educators should adopt strategies that show a supportive and positive learning environment. This can include the use of stress-reduction techniques such as mindfulness exercises, encouraging a growth mindset, and validating students' feelings about their mathematics anxiety. Educators need to be equipped with skills to identify mathematics anxiety and implement personalized support, whether through peer support systems, targeted tutoring, or specialized counseling services. Further, integrating digital tools and platforms that offer personalized feedback and interactive learning experiences can help students manage their anxiety and build confidence in their mathematical abilities. For students experiencing severe anxiety, one-on-one interventions may be necessary to provide additional support and guidance. Programs that focus on building a positive relationship between students and teachers, characterized by empathy, patience, and encouragement, are also crucial. This supportive interaction can help normalize struggles with math, reduce fear of failure, and enhance students' motivation and engagement in learning mathematics.

Despite these promising findings, the study has several limitations. First, the reliance on self-reported measures of mathematics anxiety may introduce bias and limit the accuracy of findings. Objective assessments of anxiety, such as physiological measures or observational data, could provide further understanding of the effects of anxiety on math performance. Second, the cross-sectional nature of the study

limits the ability to establish causal relationships between mathematics anxiety and academic outcomes. Future research should employ longitudinal designs to track changes in anxiety over time and examine the long-term effects of interventions. Third, the study population may not fully represent the diversity of students across different cultural and educational backgrounds. Future studies should include a more heterogeneous sample to enhance the generalizability of findings. Finally, there is a need for research that explores the relation between mathematics anxiety and other factors that may influence performance, such as socioeconomic status, language proficiency, and cultural differences. This could provide a comprehensive understanding of the nature of mathematics anxiety and its impact on student outcomes.

Conflict of interest

The authors declare no conflict of interest.

References

1. Indrawati, W. O., Arapu, L., Ihwal, M., & Sari, D. U. (2024). Student Challenges and Effective Strategies in Everyday Mathematics Learning for Junior High School Students. Jurnal Amal Pendidikan, 5(1), 24-29.
2. Dowker, A., Sarkar, A., & Looi, C. Y. (2016). Mathematics anxiety: What have we learned in 60 years?. Frontiers in psychology, 7, 508.
3. Rubinsten, O., Marciano, H., Eidlin Levy, H., & Daches Cohen, L. (2018). A framework for studying the heterogeneity of risk factors in math anxiety. Frontiers in behavioral neuroscience, 12, 291.
4. Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. Psychonomic bulletin & review, 14, 243-248.
5. O'Hara, G., Kennedy, H., Naoufal, M., & Montreuil, T. (2022). The role of the classroom learning environment in students' mathematics anxiety: A scoping review. British Journal of Educational Psychology, 92(4), 1458-1486.
6. Cassady, J. C. (2010). Anxiety in schools: The causes, consequences, and solutions for academic anxieties (Vol. 2). Peter Lang.
7. Brunyé, T. T., Mahoney, C. R., Giles, G. E., Rapp, D. N., Taylor, H. A., & Kanarek, R. B. (2013). Learning to relax: Evaluating four brief interventions for overcoming the negative emotions accompanying math anxiety. Learning and Individual Differences, 27, 1-7.
8. Fraser, B. J., & Walberg, H. J. (1991). Educational environments: Evaluation, antecedents, and consequences. Pergamon.
9. Bronfenbrenner, U. (2005). Ecological systems theory (1992). In U. Bronfenbenner (Ed.), Making human beings human: Biological perspectives on human development (pp. 106–173). Sage Publications.
10. Lewin, K. (1936). Principles of topological psychology. McGraw-Hill.
11. von Glasersfeld, E. (2002). Problems of constructivism. In Radical constructivism in action (pp. 19-25). Routledge.
12. Arifin, A., Suryaningsih, S. S., & Arifudin, O. (2024). The Relationship Between Classroom Environment, Teacher Professional Development, and Student Academic Performance in Secondary Education. International Education Trend Issues, 2(2), 151-159.
13. Khoshaim, L. S. (2024). Analysing the psychological capital influence on academic performance in an e-learning environment. Journal of Innovative Digital Transformation, 1(2), 101-117.
14. Ashcraft, M. H., & Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. Journal of Psychoeducational assessment, 27(3), 197-205.
15. Ho, H. Z., Senturk, D., Lam, A. G., Zimmer, J. M., Hong, S., Okamoto, Y., ... & Wang, C. P. (2000). The affective and cognitive dimensions of math anxiety: A cross-national study. Journal for research in Mathematics Education, 31(3), 362-379.
16. Russo, J., Downton, A., Mulligan, J., Gervasoni, A., Murphy, C., Cooke, A., & Oslington, G. (2024). Advancing mathematics learning in the early years. In Research in Mathematics Education in Australasia 2020–2023 (pp. 159-185). Springer Nature Singapore.
17. Inoferio, H. V., Espartero, M., Asiri, M., Damin, M., & Chavez, J. V. (2024). Coping with math anxiety and lack of confidence through AI-assisted Learning. Environment and Social Psychology, 9(5).
18. Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. Journal for research in mathematics education, 21(1), 33-46.
19. Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. Psychological science, 26(9), 1480-1488.
20. Barroso, C., Ganley, C. M., McGraw, A. L., Geer, E. A., Hart, S. A., & Daucourt, M. C. (2021). A meta-analysis of the relation between math anxiety and math achievement. Psychological bulletin, 147(2), 134.

21. Espino, M., Pereda, J., Recon, J., Perculeza, E., & Umali, C. (2017). Mathematics anxiety and its impact on the course and career choice of grade 11 students. International Journal of Education, Psychology and Counselling, 2(5), 99-119.
22. Wang, Y. (2023). Self-concept, learning anxiety, and performance in mathematics learning: The moderating effect of teacher cognitive activation. Eurasia Journal of Mathematics, Science and Technology Education, 19(9), em2323.
23. Liebert, R. M., & Morris, L. W. (1967). Cognitive and emotional components of test anxiety: A distinction and some initial data. Psychological reports, 20(3), 975-978.
24. Richardson, F. C., & Suinn, R. M. (1972). The mathematics anxiety rating scale: psychometric data. Journal of counseling Psychology, 19(6), 551.
25. Hopko, D. R., Mahadevan, R., Bare, R. L., & Hunt, M. K. (2003). The abbreviated math anxiety scale (AMAS) construction, validity, and reliability. Assessment, 10(2), 178-182.
26. Gonzalez-DeHass, A. R., Furner, J. M., Vásquez-Colina, M. D., & Morris, J. D. (2017). Pre-service elementary teachers' achievement goals and their relationship to math anxiety. Learning and Individual Differences, 60, 40-45.
27. Watt, H. M., Hyde, J. S., Petersen, J., Morris, Z. A., Rozek, C. S., & Harackiewicz, J. M. (2017). Mathematics—A critical filter for STEM-related career choices? A longitudinal examination among Australian and US adolescents. Sex Roles, 77, 254-271.
28. McCormick, M. P., O'Connor, E. E., Cappella, E., & McClowry, S. G. (2013). Teacher–child relationships and academic achievement: A multilevel propensity score model approach. Journal of school psychology, 51(5), 611-624.
29. Pianta, R. C. (1999). Enhancing relationships between children and teachers. American Psychological Association.
30. Baker, J. A., Grant, S., & Morlock, L. (2008). The teacher-student relationship as a developmental context for children with internalizing or externalizing behavior problems. School psychology quarterly, 23(1), 3.
31. Roorda, D. L., Koomen, H. M., Spilt, J. L., & Oort, F. J. (2011). The influence of affective teacher–student relationships on students' school engagement and achievement: A meta-analytic approach. Review of educational research, 81(4), 493-529.
32. Carmona-Halty, M., Alarcón-Castillo, K., Semir-González, C., Sepúlveda-Páez, G., Mena-Chamorro, P., Barrueto-Opazo, F., & Salanova, M. (2024). How study-related positive emotions and academic psychological capital mediate between teacher-student relationship and academic performance: a four-wave study among high school students. Frontiers in Psychology, 15, 1419045.
33. Göktaş, E., & Kaya, M. (2023). The effects of teacher relationships on student academic achievement: a second order meta-analysis. Participatory Educational Research, 10(1), 275-289.
34. Ma, L., Du, X., Hau, K. T., & Liu, J. (2018). The association between teacher-student relationship and academic achievement in Chinese EFL context: a serial multiple mediation model. Educational psychology, 38(5), 687-707.
35. Barile, J. P., Donohue, D. K., Anthony, E. R., Baker, A. M., Weaver, S. R., & Henrich, C. C. (2012). Teacher–student relationship climate and school outcomes: Implications for educational policy initiatives. Journal of youth and adolescence, 41, 256-267.
36. Appiah, J. B., Arthur, Y. D., Boateng, F. O., & Akweittey, E. (2023). Teacher-Student Relationship and Students' Mathematics Achievement: Mediating Roles of Students' Perception of Mathematics, Students' Self-Efficacy, and Cooperative Learning Strategies. Online Submission, 3(2).
37. Chui, H. S., & Chui, S. W. H. (2024). Effective teaching, teacher-student relation, student engagement and student mathematical achievement. Eurasia Journal of Mathematics, Science and Technology Education, 20(12), em2538.
38. Miller, C. (2024). Exploring the effects of teacher-student relationships in middle school (Doctoral dissertation, St. Thomas University).
39. Syahabuddin, K., Fhonna, R., & Maghfirah, U. (2020). Teacher-student relationships: An influence on the English teaching-learning process. Studies in English Language and Education, 7(2), 393-406.
40. Amerstorfer, C. M., & Freiin von Münster-Kistner, C. (2021). Student perceptions of academic engagement and student-teacher relationships in problem-based learning. Frontiers in psychology, 12, 713057.
41. Kikas, E., & Mägi, K. (2017). Does self-efficacy mediate the effect of primary school teachers' emotional support on learning behavior and academic skills?. The Journal of Early Adolescence, 37(5), 696-730.
42. Kit, P. L., Liem, G. A. D., & Chong, W. H. (2022). Teacher-student relationship and student engagement: The moderating role of educational hope. Educational Psychology, 42(9), 1180-1197.
43. Hettinger, K., Lazarides, R., & Schiefele, U. (2023). Motivational climate in mathematics classrooms: Teacher self-efficacy for student engagement, student-and teacher-reported emotional support and student interest. ZDM–Mathematics Education, 55(2), 413-426.
44. Huang, L., & Wang, D. (2023). Teacher support, academic self-efficacy, student engagement, and academic achievement in emergency online learning. Behavioral Sciences, 13(9), 704.
45. Szczygieł, M., Szűcs, D., & Toffalini, E. (2024). Math anxiety and math achievement in primary school children: Longitudinal relationship and predictors. Learning and Instruction, 92, 101906.

46. McCormick, M. P., & O'Connor, E. E. (2015). Teacher–child relationship quality and academic achievement in elementary school: Does gender matter?. Journal of Educational Psychology, 107(2), 502.
47. Yulaini, E., Rachmawati, D. W., Putri, D. N. A. O., & Chayanti, N. T. (2021). The Effect of Class Management on Economic Learning Motivation at SMA Negeri 20 Palembang. International Journal on Advanced Science, Education, and Religion, 4(4), 206-220.
48. Seif A. A. (2019). Modern Educational Psychology, Seventh Edition. Tehran: Doran.
49. Alishahi, A. G., Panahi, M., & Samadi, M. (2021). The effect of interactive management style on academic adjustment, math anxiety and academic engagement of students. Iranian journal of educational sociology, 4(4), 127-140.
50. Evertson, C. M., & Weinstein, C. S. (2006). Classroom management as a field of inquiry. Handbook of classroom management: Research, practice, and contemporary issues, 3(1), 16.
51. Janes, F. R. (1995). Interactive management: Framework, practice and complexity. In Critical Issues in Systems Theory and Practice (pp. 51-60). Boston, MA: Springer US.
52. Tuan, N. T. (2020). Identifying critical success factors through Interactive Management. In MATEC Web of Conferences (Vol. 312, p. 01004). EDP Sciences.
53. Akhtar, S., Shah, S. W. A., Rafiq, M., & Khan, A. (2016). Research design and statistical methods in Pakistan Journal of Medical Sciences (PJMS). Pakistan journal of medical sciences, 32(1), 151.
54. Swedberg, R. (2020). Exploratory research. The production of knowledge: Enhancing progress in social science, 2(1), 17-41.
55. Hunter, D., McCallum, J., & Howes, D. (2019). Defining exploratory-descriptive qualitative (EDQ) research and considering its application to healthcare. Journal of Nursing and Health Care, 4(1).
56. Singh, A. (2021). An introduction to experimental and exploratory research. Available at SSRN 3789360.
57. Chavez, J. V. (2022). Narratives of bilingual parents on the real-life use of English language: Materials for English language teaching curriculum. Arab World English Journals, 13(3).
58. Chavez, J. V., Cuilan, J. T., & Adalia, H. G. (2024). Message patterns through discourse analysis on the concept of apology and forgiveness during Ramadan among college students practicing Islam. Environment and Social Psychology, 9(3).
59. Szabelska, A., Pollet, T. V., Dujols, O., Klein, R. A., & IJzerman, H. (2021). A tutorial for exploratory research: An eight-step approach.
60. Stebbins, R. A. (2001). What is exploration. Exploratory research in the social sciences, 48, 2-17.
61. Chavez, J. V., & Del Prado, R. T. (2023). Discourse analysis on online gender-based humor: Markers of normalization, tolerance, and lens of inequality. Forum for Linguistic Studies, 5(1), 55-71.
62. Happell, B., Bennetts, W., Platania-Phung, C., & Tohotoa, J. (2016). Exploring the Scope of Consumer Participation in Mental Health Nursing Education: Perspectives From Nurses and Consumers. Perspectives in psychiatric care, 52(3).
63. Polit, D. F. (2008). Nursing research: Generating and assessing evidence for nursing practice. Lippin cott.
64. Asika, N. (2004). Research methodology: A process approach. Mukugamu & Brothers Enterprises, Lagos.
65. Rai, N., & Thapa, B. (2015). A study on purposive sampling method in research. Kathmandu: Kathmandu School of Law, 5(1), 8-15.
66. Olawale, S. R., Chinagozi, O. G., & Joe, O. N. (2023). Exploratory research design in management science: A review of literature on conduct and application. International Journal of Research and Innovation in Social Science, 7(4), 1384-1395.
67. Barratt, M. J., Ferris, J. A., & Lenton, S. (2015). Hidden populations, online purposive sampling, and external validity: Taking off the blindfold. Field methods, 27(1), 3-21.
68. Chavez, J. V. (2020). The effects of English as a second language on bilingual parents' English language dispositions. International Journal of Novel Research in Education and Learning, 7(1), 12-25.
69. Barriball, K. L., & While, A. (1994). Collecting data using a semi-structured interview: a discussion paper. Journal of Advanced Nursing-Institutional Subscription, 19(2), 328-335.
70. Alshenqeeti, H. (2014). Interviewing as a data collection method: A critical review. English linguistics research, 3(1), 39-45.
71. Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. Journal of advanced nursing, 72(12), 2954-2965.
72. Naz, N., Gulab, F., & Aslam, M. (2022). Development of qualitative semi-structured interview guide for case study research. Competitive Social Science Research Journal, 3(2), 42-52.
73. Pope, C., & Mays, N. (Eds.). (2020). Qualitative research in health care (pp. 111-133). Oxford, UK:: Wiley-Blackwell.
74. Hardon, A., Hodgkin, C., & Fresle, D. (2004). How to investigate the use of medicines by consumers. In How to investigate the use of medicines by consumers (pp. 89-89).
75. Rubin, H. J., & Rubin, I. S. (2011). Qualitative interviewing: The art of hearing data. Sage.

76. Hoyle, R. H., Harris, M. J., & Judd, C. M. (2002). Research Methods in Social Relations. London: Thomson Learning. Inc. UK.
77. Galletta, A. (2013). Mastering the semi-structured interview and beyond: From research design to analysis and publication. New York University Press.
78. Monday, T. U. (2020). Impacts of interview as research instrument of data collection in social sciences. Journal of Digital Art & Humanities, 1(1), 15-24.
79. McGehee, N. G. (2012). Interview techniques. In Handbook of research methods in tourism. Edward Elgar Publishing.
80. Elhami, A., & Khoshnevisan, B. (2022). Conducting an Interview in Qualitative Research: The Modus Operandi. Mextesol Journal, 46(1), 1-7.
81. Seidman, I. (2006). Interviewing as qualitative research: A guide for researchers in education and the social sciences. Teachers College.
82. Chavez, J. V., & Ceneciro, C. C. (2024). Discourse analysis on same-sex relationship through the lens of religious and social belief systems. Environment and Social Psychology, 9(1), 1912.
83. Creswell, J. W., & Creswell, J. D. (2017). Research design: Qualitative, quantitative, and mixed methods approaches. Sage.
84. Luo, L., & Wildemuth, B. M. (2009). Semistructured interviews. Applications of social research methods to questions in information and library science, 232.
85. Kallio, A. A. (2015). Factional stories: Creating a methodological space for collaborative reflection and inquiry in music education research. Research Studies in Music Education, 37(1), 3-20.
86. Gunawan, J., Marzilli, C., & Aungsuroch, Y. (2022). Online 'chatting'interviews: An acceptable method for qualitative data collection. Belitung Nursing Journal, 8(4), 277.
87. Joffe, H. (2011). Thematic analysis. Qualitative research methods in mental health and psychotherapy: A guide for students and practitioners, 209-223.
88. Braun, V., & Clarke, V. (2012). Thematic analysis. American Psychological Association. APA Handbook of Research Methods in Psychology, 2, 57-71.
89. Finlay, L. (2021). Thematic analysis: the 'good', the 'bad' and the 'ugly'. European Journal for Qualitative Research in Psychotherapy, 11, 103-116.
90. Langridge, D. (2004). Introduction to research methods and data analysis in psychology. Harlow: Pearson.
91. Terry, G., Hayfield, N., Clarke, V., & Braun, V. (2017). Thematic analysis. The SAGE handbook of qualitative research in psychology, 2(17-37), 25.
92. Braun, V., & Clarke, V. (2021). Can I use TA? Should I use TA? Should I not use TA? Comparing reflexive thematic analysis and other pattern-based qualitative analytic approaches. Counselling and psychotherapy research, 21(1), 37-47.
93. Shaw, R. (2010). Embedding reflexivity within experiential qualitative psychology. Qualitative research in psychology, 7(3), 233-243.
94. Jebreen, I. (2012). Using inductive approach as research strategy in requirements engineering. International Journal of Computer and Information Technology, 1(2), 162-173.
95. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101.
96. Guest, G., MacQueen, K. M., & Namey, E. E. (2012). Introduction to applied thematic analysis. Applied thematic analysis, 3(20), 1-21.
97. Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. Current directions in psychological science, 11(5), 181-185.
98. Daker, R. J., Gattas, S. U., Necka, E. A., Green, A. E., & Lyons, I. M. (2023). Does anxiety explain why math-anxious people underperform in math?. npj Science of Learning, 8(1), 6.
99. Ramirez, G., Shaw, S. T., & Maloney, E. A. (2018). Math anxiety: Past research, promising interventions, and a new interpretation framework. Educational psychologist, 53(3), 145-164.
100. Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. Journal of experimental psychology: General, 130(2), 224.
101. Maloney, E. A., Schaeffer, M. W., & Beilock, S. L. (2013). Mathematics anxiety and stereotype threat: shared mechanisms, negative consequences and promising interventions. Research in Mathematics Education, 15(2), 115-128.
102. Orbach, L., Herzog, M., & Fritz, A. (2020). State-and trait-math anxiety and their relation to math performance in children: The role of core executive functions. Cognition, 200, 104271.
103. Qu, Z., Chen, J., Li, B., Tan, J., Zhang, D., & Zhang, Y. (2020). Measurement of high-school students' trait math anxiety using neurophysiological recordings during math exam. IEEE Access, 8, 57460-57470.
104. Park, D., Ramirez, G., & Beilock, S. L. (2014). The role of expressive writing in math anxiety. Journal of Experimental Psychology: Applied, 20(2), 103.

105. Pizzie, R. G., McDermott, C. L., Salem, T. G., & Kraemer, D. J. (2020). Neural evidence for cognitive reappraisal as a strategy to alleviate the effects of math anxiety. Social Cognitive and Affective Neuroscience, 15(12), 1271-1287.
106. Megreya, A. M., & Al-Emadi, A. A. (2024). The impact of cognitive emotion regulation strategies on math and science anxieties with or without controlling general anxiety. Scientific Reports, 14(1), 19726.
107. Barbag, L. I. (2024). Teachers' Perceptions of Social-Emotional Learning Strategies for High School Students Experiencing Mathematics Anxiety (Doctoral dissertation, National University).
108. Brooks, A. W. (2014). Get excited: reappraising pre-performance anxiety as excitement. Journal of Experimental Psychology: General, 143(3), 1144.
109. Gross, J. J. (2015). Emotion regulation: Current status and future prospects. Psychological inquiry, 26(1), 1-26.
110. Pizzie, R. G., & Kraemer, D. J. (2021). The association between emotion regulation, physiological arousal, and performance in math anxiety. Frontiers in psychology, 12, 639448.
111. Passolunghi, M. C., De Vita, C., & Pellizzoni, S. (2020). Math anxiety and math achievement: The effects of emotional and math strategy training. Developmental science, 23(6), e12964.
112. Sarkar, A., Dowker, A., & Kadosh, R. C. (2014). Cognitive enhancement or cognitive cost: trait-specific outcomes of brain stimulation in the case of mathematics anxiety. Journal of Neuroscience, 34(50), 16605-16610.
113. Rozek, C. S., Ramirez, G., Fine, R. D., & Beilock, S. L. (2019). Reducing socioeconomic disparities in the STEM pipeline through student emotion regulation. Proceedings of the National Academy of Sciences, 116(5), 1553-1558.
114. Lewis, M., & Saarni, C. (1985). Culture and emotions. In The socialization of emotions (pp. 1-17). Boston, MA: Springer US.
115. Lutz, C. (1985). Cultural patterns and individual differences in the child's emotional meaning system. In The socialization of emotions (pp. 37-53). Boston, MA: Springer US.
116. Rosaldo, M. Z. (1980). Knowledge and passion (Vol. 4). Cambridge University Press.
117. Shweder, R. A. (1984). Culture theory: Essays on mind, self, and emotion. Cambridge University Press.
118. Duffel, J. C., Beland, K., & Frey, K. (2006). The second step program: Social-emotional skills for violence prevention. The educator's guide to emotional intelligence and academic achievement: Emotional learning in the classroom, 161-171.
119. Kusché, C. A., & Greenberg, M. T. (2006). Teaching Emotional Literacy in Elementary School Classrooms. The Educator's Guide to Emotional Intelligence and Academic Achievement: Social-Emotional Learning in the Classroom, 150.
120. Bates, E. M. (2023). A Correlational Study on the Influence of Teacher-Student Relationships on Teachers' Math Self-Efficacy and Mathematical Anxiety in Students in Lower Elementary Grades. Liberty University.
121. Semeraro, C., Giofrè, D., Coppola, G., Lucangeli, D., & Cassibba, R. (2020). The role of cognitive and non-cognitive factors in mathematics achievement: The importance of the quality of the student-teacher relationship in middle school. Plos one, 15(4), e0231381.
122. Chang, H., & Beilock, S. L. (2016). The math anxiety-math performance link and its relation to individual and environmental factors: A review of current behavioral and psychophysiological research. Current Opinion in Behavioral Sciences, 10, 33-38.
123. Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. Review of educational research, 68(2), 202-248.
124. Liu, X. M., & Zhou, L. (2007). The relationships of academic feedback, mathematic self-efficacy and mathematic achievement of students in grade seven. Chinese Journal of Clinical Psychology.
125. Shao, L. (2005). An experiment of enhancing students' English learning and self-efficacy. Vocational Education Research, 7, 74-75.
126. Tang, L. X., & He, J. M. (2006). On the favorable interaction of self-efficacy between teacher and students in PE teaching. Journal of Jinxing University, 18(3), 111-114.
127. Abdullah, M. C., Elias, H., Mahyuddin, R., & Uli, J. (2009). Adjustment amongst first year students in Malaysian University. European Journal of social sciences, 3.
128. Kayıkçı, K. (2009). The effect of classroom management skills of elementary school teachers on undesirable discipline behaviour of students. Procedia-Social and Behavioral Sciences, 1(1), 1215-1225.