



# Effects of Peer Tutoring Strategies on Mathematical Achievements in Relation to Mathematics Anxiety: A Review

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**Abstract:** *In the last four decades, peer tutoring has grown in popularity, and its academic benefits extend to all levels of education. Nonetheless, by placing mathematics education in context, one can better comprehend the function and indispensability of peer tutoring in this particular domain. Since the dawn of civilization, mathematics has been an indispensable component of contemporary life, and its significance has increased substantially as a result of technological and commercial advancements. Guaranteeing equitable access to mathematics education of superior quality is a fundamental objective of the Indian government. The extent to which instructors are responsible for imparting mathematical comprehension and skill-based knowledge has grown substantially. Educators face an increasing difficulty in differentiating instruction in order to ensure adequate time for practice and corrective feedback when the number of students in the classroom rises. Furthermore, a number of notable concerns have been identified in the field of mathematics education. These include a lack of supportive instructors, a monotonous and uninspiring curriculum, apprehension and disillusionment towards mathematics, and instruction that is preoccupied with grades and examinations. Concerning mathematics problems, classes, and examinations, mathematics anxiety is a distressing and apprehensive sensation that poses a grave threat to students who struggle to comprehend the subject. Academic underachievement and low self-esteem are both potential outcomes of anxiety. It is postulated to commence in the fourth grade of a child's academic career and progress throughout their secondary schooling. Mathematics anxiety can be influenced by both parents and teachers, and both can help mitigate physical and mental symptoms, according to research. Strategies that have been shown to be effective in alleviating mathematics anxiety encompass engaging in practice sessions involving a diverse range of mathematical problems, evading time constraints on examinations, and receiving constructive feedback on errors made. Individuals with an extreme aversion to mathematics frequently abstain from studying the subject, thereby*

*compromising their mathematical competence and limiting their ability to pursue substantial professional prospects. Mathematical anxiety disrupts cognitive processing by impairing ongoing operations in working memory. Consequently, those who experience intense mathematics anxiety demonstrate diminished levels of mathematical proficiency and accomplishment, which ultimately culminates in a decline in performance on standardised assessments.*

**Keywords:** *Mathematics Education, Peer-tutoring, Mathematics anxiety, Self Concept, Mathematics.*

## **Content**

To facilitate or mediate the learning and engagement of other students, peer tutors will assume the role of instructors. Peer tutoring has been practiced since the earliest days of education, when one child trained another in subject matter where the former was an authority and the latter was a beginner. A small group of students (or one) receives individualised and personalised instruction from a fellow student (or students) as part of the peer tutoring teaching method. Self-study is not a novel concept, despite the fact that it has become increasingly prevalent in recent years. Since at least the time of the ancient Greeks, peer tutoring has been an established practice. In the context of peer tutoring, students assist one another and gain knowledge through instructing. The approach involves the teacher acting as a facilitator who concurrently monitors, intervenes, and evaluates both group and individual performance, thereby enabling and equipping students to acquire knowledge by fostering critical and creative thinking and teamwork. This method empowers both the tutor and the tutee with self-assurance. Tutors believe they possess the necessary skills and knowledge to provide assistance. When the instructor provides positive reinforcement, the tutee also experiences an increase in confidence.

The use of peer tutoring as an instructional method has grown in popularity over the past forty years. The scholarly advantages of peer tutoring have been substantiated by literature reviews and meta-analyses spanning all levels of education, from infancy to college and university. However, the scholarly advantages of mathematics peer instruction are extensively documented at all educational levels. Nevertheless, the significance and necessity of mathematics education provide context for comprehending the function and necessity of peer tutoring in this field. The historical significance of mathematics can be traced back to the early stages of civilization, when its utility multiplicatively expanded. The proliferation of technological and commercial innovations has significantly amplified the significance and demand for mathematics. Presently, mathematics is regarded as the foundation of modern, organised existence. The absence of mathematics would have rendered existence anarchic. Time and money are two instrumental factors that govern contemporary existence; both are mathematical concepts. Finance management can be traced back to its foundations in the narratives of successful individuals.

Mathematical principles are indispensable in virtually every facet of daily existence. Mathematics is required for a variety of tasks, including but not limited to: timely arrival at the workplace, timely completion of assigned tasks, cooking, purchasing dresses, establishing a kitchen garden, budgeting for the household, office, and country, financing groceries, clothing, children's fees, electricity bills, purchasing items on sale, balancing income and

expenditures, and strategizing and saving for the future. It appears that our contemporary world could not exist without numbers. We were able to discern time, determine distance and weight, make instantaneous phone calls, and do a great deal more with the aid of numbers. Additionally, mathematics contributes significantly to the aesthetic dimension of existence. The application of the mathematical principles of proportion and ratio results in a visually appealing painting. Puzzles and diversions based on mathematics have the capacity to promote physical well-being. It sharpens and challenges the mental faculties in a manner that is unparalleled by any other subject. The students' logical and rational reasoning is enhanced. Mathematics not only possesses fundamental breadth-of-life value, but also serves an enormous vocational purpose. In order to pursue any vocation, including accountancy, finance, engineering, business, medical, or any other, mathematics is an essential prerequisite. Mathematics's significance does not end here. Additionally, it has disciplinary merits. Mathematics imparts honesty, consistency, and timeliness to an individual's character. It fosters diligence and diligence among students, cultivates precision and brevity, and thus enhances their aptitude for effective communication. Other fields of knowledge exhibit correlations with mathematics.

The Kothari Commission (1966–1966) determined that mathematics, being an essential component of national development, ought to be mandated for all students during their initial ten years of instruction as part of their general education. It has been noted that nations lacking a progressive mathematics curriculum experience relatively sluggish economic and social development. Additionally, Napoleon stated, "Progress and enhancement in mathematics are intrinsically linked to state prosperity." Mathematics no longer merely serves as the language of science; it now makes direct and fundamental contributions to the fields of business, finance, health, and defence. It provides students with career opportunities. It empowers individuals to make well-informed choices.

NCERT has determined that all students have the capacity to learn mathematics and that all students are required to learn mathematics, thereby ensuring that all children have access to mathematics education of the utmost calibre. The Indian government is dedicated to ensuring that mathematics education is both accessible and engaging for all children. The importance of the teacher's role in disseminating mathematical understanding and skill-based knowledge, along with desirable attitudes and interests, has increased significantly. As the number of students in classrooms with varying abilities, needs, interests, levels of readiness, learning profiles, and aspirations rises, it becomes more difficult for educators to differentiate instruction in order to provide sufficient time for additional practice and corrective feedback and to meet the needs of all levels of need effectively. Furthermore, several significant issues have been identified in the realm of mathematics education. These include a considerable proportion of students experiencing apprehension and disillusionment towards mathematics, a curriculum that is tedious and uninteresting, instruction that is centred around examinations and grades and emphasises rote and mechanical computations, and a dearth of supportive instructors. A radical shift in the teaching and learning of mathematics is therefore required.

A fundamental component of each academic programme, mathematics exhibits a robust association with math self-concept, an individual's subjective perceptions and convictions regarding their own proficiency in the subject. Previous research has noted that successes and other positive life events contribute to the development of a positive self-concept, while failure, frustration, and other negative experiences have the opposite effect. As a result, students' mathematical self-concept is significantly influenced by their mathematical achievement, which motivates them, enhances their self-assurance, and improves their capacity to attain advanced mathematical levels. It thus produces a cyclical effect. Mathematics has garnered considerable attention within the realm of education as a whole, and specifically in mathematics, due to the observation that self-concept is intricately linked to personal attributes such as learning, motivation, attitudes, perception, and adjustment—factors that ascertain an individual's academic and extracurricular achievements. Mathematics self-concept is an academic self-concept that is becoming increasingly significant for the following reasons: (i) it is one of the most thoroughly researched domains of self-concept; (ii) it is a highly sex-typed domain; and (iii) it is one of the domains of self-concept most strongly associated with learning gains and achievement-related decisions. The notion that mathematical prowess is an inherent quality and that success in the field is limited to a specific subset of individuals carries little significance in the contemporary educational landscape. The instructor is responsible for dispelling these erroneous assumptions. Academic self-concept, or the extent to which students have a positive perception of themselves, is enhanced through peer tutoring. Topping and Bamford proposed that instructors demonstrate effective coping mechanisms by first confronting and then surmounting challenges; furthermore, they suggested that this would have favourable implications for students' self-assurance and scholastic performance.

Mathematics anxiety is a distressing and apprehensive sensation regarding mathematics or taking mathematics exams; it poses a serious threat to students who struggle to master the subject. A pupil who has not adequately prepared will be anxious about failing a mathematics exam. While an extreme degree of dread is undeniably detrimental and distressing, a moderate degree of fear in specific circumstances can serve as a motivating factor for students to enhance their study efforts with the intention of excelling on examinations. Anxiety has been found to be the cause of both diminished self-esteem and poor academic performance. Dreger and Aiken initially conceptualised mathematics anxiety as a syndrome characterised by an emotional reaction to mathematics and arithmetic. Mathematics anxiety refers to an irrational and vindictive fear of the subject matter.

Anxiety and uneasiness regarding mathematics problems, classes, and/or examinations constitute mathematics anxiety. It is hypothesised to commence during the child's fourth grade year and escalate over the course of their secondary school career. Mathematics anxiety is a legitimate phobia that manifests as an anxiety reaction, carrying with it educational consequences that are both immediate and long-lasting. Mathematics anxiety extends beyond being a psychological issue, as it may lead students to drop out of advanced mathematics courses beyond what is required for high school and to reconsider the subject in the context of college or career prospects. Research has demonstrated that mathematics anxiety can be influenced by both parents and teachers, and that both can help alleviate the physical and mental symptoms that children may be experiencing. It has been demonstrated that



practicing with a variety of mathematical problems, not having time constraints on exams, and receiving encouragement for mistakes are all effective methods for reducing mathematics anxiety. Extremely mathematics-averse people have a propensity to avoid the subject, which undermines their mathematical proficiency and precludes them from pursuing significant career opportunities. Mathematical anxiety impairs ongoing operations in working memory, thereby interfering with cognitive processing. One regrettable outcome of the avoidance tendency is that individuals with high levels of mathematics anxiety attain reduced levels of mathematical competence and achievement in comparison to those who do not experience such anxiety. Consequently, those with mathematics anxiety avoid the subject in the classroom and evidently retain less of the material taught; consequently, their performance on standardised tests suffers.

Personal characteristics, including gender and self-efficacy, significantly influence mathematical apprehension. Even among young children, Schunk has demonstrated through his research with elementary school students that low levels of self-efficacy are associated with poorer mathematics performance and attitudes. Schunk's research has demonstrated that students' self-perceptions of their mathematical competence can be improved via strategy training; this, in turn, results in increased mathematical achievement, enhanced perseverance, and an innate enthusiasm for the subject. Additional individual factors contributing to mathematics anxiety include reticence in posing inquiries during class, timidity, self-doubt, and prejudiced beliefs such as the notion that mathematical success is exclusive to males. Students who rely on rote memorization without comprehension may develop anxiety towards mathematics, according to Oberlin, Steele, and Arth. In addition, mathematics anxiety is caused by negative classroom experiences, parental pressure, insensitive and pedagogically inadequate instructors, long-standing preconceptions about mathematics, and a teacher-centered classroom environment. Multiple adverse outcomes are associated with students who suffer from severe levels of mathematics anxiety. These include developing pessimistic attitudes towards the subject, exhibiting avoidance behaviour, experiencing diminished self-esteem and self-efficacy, and achieving subpar performance in mathematics. Nevertheless, the expressions of mathematics anxiety could potentially stem from unrecognised early adversities in the subject that precipitated a downward trajectory in both performance and perception of mathematics.

Mathematical anxiety is obviously a multifaceted and intricate concept. The complexities of mathematics anxiety render its causes and effects difficult to comprehend, given the multitude of potential contributing factors. Mathematics anxiety is characterised by feelings of mental disarray, panic, helplessness, and terror that manifest in certain individuals when confronted with the task of solving a mathematical problem. A mathematical phobia is an extreme emotional state of anxiety that an individual experiences regarding his or her capacity to comprehend and perform mathematical operations. Math anxiety progresses to a dread of mathematics. Individuals who have a mathematics phobia believe they are incapable of performing mathematical tasks. Anxiety in mathematics is an affective rather than a cognitive issue. Nevertheless, mathematics anxiety hinders a student's capacity to acquire mathematical knowledge, thereby giving rise to an intellectual dilemma. Mathematics anxiety may induce irrational

thought processes or behaviour, compels individuals to avoid mathematics classes until the last minute, or generates pressure that motivates such behaviour.

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